Vol. 12, No. 21
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Energy Research Abstracts

Abstracts 42913-44814

Office of Scientific & Technical Information
UNITED STATES DEPARTMENT OF ENERGY

CURRENT INFORMATION ON ENERGY

To provide immediate and complete coverage of literature related to major Department programs, the Office of Scientific and Technical Information provides an on-line retrieval system, data bases, and current-awareness publications. The Energy Data Base (EDB), which contains all unclassified, unlimited energy and nuclear related information processed by OSTI since 1974, and the Nuclear Science Abstracts Data Base (NSA), which covers nuclear information from 1948 through June 1976, are available for machine searching using commercial on-line retrieval systems. All information in the publications listed below, plus additional backup information, is included in the EDB. Current information being added to the EDB is available for on-line searching via the OSTI Automated Retrieval System (OARS) accessible to DOE and contractors through the Integrated Technical Information System (ITIS).

The publications described below and access to ITIS/OARS are available to Department of Energy and contractor components from the Office of Scientific and Technical Information, U. S. Department of Energy, P. O. Box 62, Oak Ridge, TN 37831/Telephone (615) 576-1301; FTS 626-1301.

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A monthly abstract journal devoted to the analysis of energy research, conservation, and policy. Scope and coverage are limited to substantive articles or reports and emphasize legislative, regulatory, and other legal aspects, as well as social, economic, and environmental impacts. *EAPA* is available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The annual subscription price is $63.00 for domestic (North America) or $78.75 for foreign (outside North America) subscribers; a single issue is $6.00 or $7.50, respectively.

Energy Research Abstracts (ERA)

A comprehensive semimonthly abstract journal devoted to all areas of energy-related information produced by the Department of Energy, other U. S. government organizations, and foreign governments. *ERA* is available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The annual subscription price for the 24 issues is $146.00 for domestic (North America) subscribers or $182.50 for foreign (outside North America) subscribers. A single issue is $14.00 or $17.50, respectively.

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DOE is prepared to grant exclusive or nonexclusive, revocable licenses under DOE-owned U. S. patents and patent applications; this semiannual publication provides abstracting and indexing coverage of this literature. *PAL* is available as PB87-946800 from the National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161 on a standing order basis through an NTIS Deposit Account. To establish an NTIS account, send the minimum $25.00 deposit to NTIS, Attn: Customer Accounts. A single issue is $12.00 for domestic (North America) and $24.00 for foreign (outside North America).

Energy Meetings (EM)

A monthly listing of conferences, symposia, workshops, etc., pertaining to DOE's programmatic interests. *EM* is available on subscription (use PB87-901500) from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161. The annual subscription price is $70.00 for domestic subscribers and $140.00 for subscribers outside the North American continent; a single issue is $8.00 and $16.00, respectively.

The following semimonthly bulletins are also available from the National Technical Information Service. The annual subscription rate for one volume (calendar) year (24 issues; no indexes) is $80.00 for domestic (North America) and $160.00 for foreign (outside North America) subscribers; use the identifying order number (PB- No.) when subscribing.

***Acid Precipitation (APC)*–PB87-901000.** Acid precipitation, including effects and possible control measures.

***Buildings Energy Technology (BET)*–PB87-900700.** Technology required for energy conservation in buildings of all types.

***Coal-Based Synfuels (CBS)*–PB87-901400.** Conversion of coal into gaseous or liquid fuels.

***Coal Combustion and Utilization (CCU)*–PB87-914400.** Coal combustion, including fluidized bed combustion, and direct utilization of coal for power generation, fuel cells, and MHD generators.

***Coal Preparation and Pollution Control (CPC)*–PB87-900800.** Coal preparation and cleaning and reducing pollution from its direct combustion.

***Direct Energy Conversion (DEC)*–PB87-946600.** Photovoltaics, magnetohydrodynamics, electrohydrodynamics, thermoelectrics, thermionics, and fuel cells.

***Energy from Biomass (EFB)*–PB87-900600.** Biomass production, conversion, and utilization for energy.

***Geothermal Energy Technology (GET)*–PB87-914700.** Exploration, development, and utilization of geothermal resources.

***Heavy-Ion Reactions (HIR)*–PB87-900500.** Heavy-ion ($A > 4$) reactions.

***Laser Research (LAR)*–PB87-901100.** Laser research and development, excluding applications.

***Nuclear Fuel Cycle (NFC)*–PB87-913400.** Both front and back ends of the nuclear fuel cycle.

***Nuclear Reactor Safety (NRS)*–PB87-913500.** Accident analysis, safety systems, radiation protection, decommissioning and dismantling, and security measures.

***Radioactive Waste Management (RWM)*–PB87-902900.** Management aspects of transport and storage, waste processing, waste disposal, waste storage, radioactive effluents, and shipping containers.

***Solar Thermal Energy Technology (STT)*–PB87-901200.** Research and development of efficient and reliable solar thermal conversion systems.

***Transportation Energy Research (TER)*–PB87-900900.** Energy-efficient advanced automotive propulsion systems and transportation energy conservation.

***Unconventional Petroleum (UCP)*–PB87-901300.** Secondary and tertiary recovery of petroleum and oil shales and tar sands.

INTERNATIONAL ENERGY PUBLICATIONS

The Office of Scientific and Technical Information (OSTI) cooperates in the publication of international abstract journals with the following: (1) International Atomic Energy Agency, International Nuclear Information System, Vienna, Austria, for *Atomindex;* (2) International Energy Agency, Biomass Conversion Technical Information Service, Dublin, Ireland, for *Biomass Abstracts;* and (3) International Energy Agency, IEA Coal Research, London, England, for *Coal Abstracts.* In each case, the cognizant foreign agency provides the non-U. S. information to OSTI for inclusion in the Energy Data Base; in turn, OSTI provides the U. S. information for input into the respective journal.

Atomindex

A semimonthly abstract journal providing worldwide coverage of information on nuclear science and technology. *Atomindex* is available by subscription from Bernan Associates—UNIPUB, 10033-F King Highway, Lanham, MD 20706. The cost of an annual subscription, 24 semimonthly issues and semiannual and annual cumulative indexes, is $355.

Biomass Abstracts

A bimonthly abstract journal with comprehensive coverage of information on the conversion of biomass to energy. *Biomass Abstracts* is available free to DOE components and contractors from OSTI. Non-DOE organizations may obtain *Biomass Abstracts* from Biomass Conversion Technical Information Service, Institute for Industrial Research and Standards, Ballymun Road, Dublin 9, Ireland, for 60 IR pounds per year for participating countries and 90 IR pounds per year for nonparticipating countries. Make checks payable to the Institute.

Coal Abstracts

A monthly abstract journal providing comprehensive worldwide coverage of information in the field of coal science and technology. *Coal Abstracts* is available to DOE components and contractors from OSTI. Non-DOE organizations may obtain *Coal Abstracts* from IEA Coal Research, Technical Information Service, 14-15 Lower Grosvenor Place, London SW1W 0EX, England, for 110 pounds sterling per year.

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ENERGY RESEARCH ABSTRACTS

ABOUT THE OFFICE OF SCIENTIFIC AND TECHNICAL INFORMATION

The Office of Scientific and Technical Information (OSTI) in Oak Ridge, Tennessee, has been the national center for scientific and technical information for the Department of Energy (DOE) and its predecessor agencies since 1946. In developing and managing DOE's technical information program, OSTI places under bibliographic control not only DOE-originated information but also worldwide literature on scientific and technical advances in the energy field and announces the source and availability of this information. Although the literature of science is emphasized, coverage extends to DOE programmatic, socioeconomic, environmental, legislative/regulatory, energy analysis, and policy-related areas. To accomplish the mission of furnishing centralized support for Departmental elements in managing their scientific and technical information, OSTI builds and maintains computerized data bases and disseminates information via computerized retrieval systems and announcement publications such as abstract journals, bibliographies, and bulletins. Direct access to OSTI's Energy Data Base (EDB) and Nuclear Science Abstracts Data Base (NSA) is available to the U. S. scientific community through commercial on-line retrieval systems. Access to these data bases from outside the United States is available only through formal exchange agreements. The current-year EDB records, DOE Research-In-Progress, and various other specialized DOE data bases are available to DOE offices and contractors and other government agencies through the OSTI Automated Retrieval System (OARS), which is a major component of the Integrated Technical Information System (ITIS). In addition to providing access to the OSTI on-line systems, ITIS serves as a gateway to other government and commercial systems and provides information merging for customized information products. The Office of Scientific and Technical Information has developed systems to record and communicate energy-related research-in-progress information, to track research report deliverables from DOE contractors, to test and make available DOE-funded computer software programs with scientific and management applications, and to produce special publications in support of DOE program offices. To manage DOE's technical information resources effectively, OSTI's program is one of continual development and evaluation of new information products, systems, and technologies.

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Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U. S. Department of Energy, its laboratories, energy centers and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. The user should remain aware that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.

ERA is comprehensive in its subject scope, encompassing the DOE's research, development, demonstration, and technological programs resulting from its broad charter for energy sources, supplies, safety, environmental impacts, and regulation.

ERA is available on an exchange basis to universities, research institutions, industrial firms, and publishers of scientific information. Inquiries should be directed to the Office of Scientific and Technical Information, P. O. Box 62, Oak Ridge, TN 37831.

ERA is available to the public on a subscription basis from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The subscription rate for the 24 semimonthly issues is $146.00 for domestic subscribers and $182.50 for foreign subscribers. A single issue costs $14.00 (domestic) or $17.50 (foreign). The cumulative indexes will be available in printed form from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The GPO Stock Number is 061-000-00697-4 and the price is $142.00 for the Volume 11 indexes. The cumulative indexes are also available in microfiche form from the National Technical Information Service, U. S. Department of Commerce, Springfield, VA 22161.

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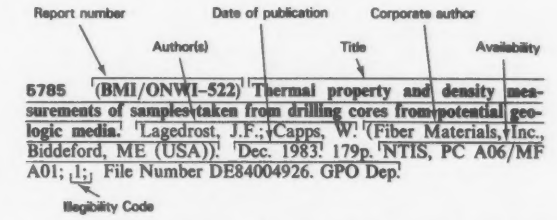
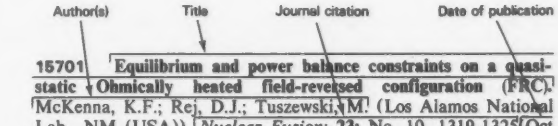
The principal elements of abstract entries for a typical research and development report and a typical technical journal article are illustrated below.



5785 (BMI/ONWI-522) Thermal property and density measurements of samples taken from drilling cores from potential geologic media. Lagedrost, J.F.; Capps, W. (Fiber Materials, Inc., Biddeford, ME (USA)). Dec. 1983. 179p. NTIS, PC A06/MF A01; 1; File Number DE84004926. GPO Dep.

Abstract

Density, steady-state conductivity, enthalpy, specific heat, heat capacity, thermal diffusivity and linear thermal expansion were measured on 59 materials from core drill samples of several geologic media, including rock salt, basalt, and other associated rocks from 7 potential sites for nuclear waste isolation. The measurements were conducted from or near to room temperature up to 500°C, or to lower temperatures if limited by specimen cracking or fracturing. Ample documentation establishes the reliability of the property measurement methods and the accuracy of the results.



15701 Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC). McKenna, K.F.; Rej, D.J.; Tuszewski, M. (Los Alamos National Lab., NM (USA)). *Nuclear Fusion;* **23:** No. 10, 1319-1325 (Oct 1983).

Abstract

Zero-dimensional power balance calculations are performed for a quasi-static, purely Ohmically heated field-reversed configuration. Without compression, the constraint imposed by radial pressure balance limits the power input. Estimates of the energy loss from impurity line radiation as well as from classical and anomalous transport are given. Effects of cold puff gas injection are also investigated.

INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA).* Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

● Corporate Author Index

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

5785 (BMI/ONWI-522) **Thermal property and density measurements of samples taken from drilling cores from potential geologic media.** Lagedrost, J.F.; Capps, W. **(Fiber Materials, Inc., Biddeford, ME (USA)).** Dec. 1983. 179p. NTIS File Number DE84004926. GPO Dep.

is indexed as:

Fiber Materials, Inc., Biddeford, ME (USA)

● Personal Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

Capps, W., *See* Lagedrost, J. F.
Lagedrost, J.F., Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
McKenna, K.F., Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;US)
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● Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

SALT DEPOSITS
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● Contract Number Index

DOE technical report literature is indexed using contract numbers. This index contains the contract number with corresponding abstract and report numbers.

AC06-76RL01830	**Fiber Materials, Inc., Biddeford, ME (USA)**	
	9:5785	BMI/ONWI-522

● Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. Patents and conference papers are indexed here as a matter of convenience. When a report is supplied under a File Number, that number is included in the availability statement. A file number–report number correlation is included for convenience.

BMI/ONWI-522	9:5785	NTIS, PC A09/MF A01. File Number DE84004926, Distribution Category MN-70

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National Institutes of Health
National Library of Medicine
Bethesda, MD

NOVA Information Services Company
Commack, NY

Communication concerning the editorial policy and content of *Energy Research Abstracts* should be addressed to the Editor, *Energy Research Abstracts,* Office of Scientific and Technical Information, P. O. Box 62, Oak Ridge, TN 37831.

SUBJECT CONTENTS (NUMERICAL LISTING)

Six-digit subject category numbers are used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's computerized bibliographic information system. The six-digit category numbers are utilized as if they were three pairs of two-digit numbers, the first two pairs being used to arrange the abstract content of *Energy Research Abstracts*. The following listing includes the totality of the 40 first-level and 289 second-level subject categories used. Because each issue of *ERA* announces only those documents becoming available during a semimonthly period, some subject categories may not be represented in every issue. The complete subject category scheme with scope definitions and limitations is available as DOE/TIC-4584-R6 from NTIS for $9.50.

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ENERGY RESEARCH ABSTRACTS

01 COAL AND COAL PRODUCTS

REFER ALSO TO CITATION(S) 43519

42913 (DOE/METC—87/6081) Symposium proceedings: Fourteenth biennial lignite symposium on the technology and utilization of low-rank coals. (North Dakota Univ., Grand Forks (USA). Energy Research Center; USDOE Morgantown Energy Technology Center, WV). 1987. 766p. (CONF-870517—). NTIS, PC A99/MF A01; 1; GPO Dep. File Number DE87012948.

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

The Biennial Lignite Symposia have grown from the original North Dakota Lignite Forum held in 1958 to the present international symposium. These meetings have expanded beyond lignite to include subbituminous coal, brown coal, low-grade (not necessarily low-rank) coals, and peat. The Biennial Lignite Symposia clearly continue to meet a growing need for information exchange through the formal presentations and informal discussions. An important reason for having this year's Symposium in Dallas was to provide the opportunity for attendees to visit the region's lignite mines and power plants. Papers in the proceedings have been entered individually into EDB and ERA.

0103 Preparation

REFER ALSO TO CITATION(S) 42948

42914 (BNL—39995) Anaerobic microbial dissolution of toxic metals from energy residues. Francis, A.J.; Dodge, C.J. (Brookhaven National Lab., Upton, NY (USA)). May 1987. Contract AC02-76CH00016. 4p. (CONF-870937—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013304.

From 6. international conference on heavy metals in the environment; New Orleans, LA, USA (15 Sep 1987).

Microbial dissolution of toxic metals from coal beneficiation residues was studied under aerobic and anaerobic conditions. Aerobically, native autotrophic bacteria solubilized varying amounts of As, Cr, Cu, Mn, Ni, Pb, and Zn. Dissolution of the above metals was increased by severalfold when inorganic nutrients N and P were supplemented. Under anaerobic conditions native anaerobic bacteria solubilized significant amounts of Fe, Cr, and Mn when amended with carbon and nitrogen. Selective chemical extraction analyses of coal residues indicate the association of most trace metals with pyrite, Fe-oxide, and a soluble phase, possibly ferric sulfate. These results indicate that the predominant mechanism of microbial dissolution of metals from coal residues under aerobic conditions is direct bacterial oxidation of pyrite and acid production; under anaerobic conditions are due to direct bacterial reduction of iron and manganses oxides and release of trace metals coprecipitated with the oxides.

0104 Processing

REFER ALSO TO CITATION(S) 42958, 42959, 42960, 43537, 43683

42915 (DOE/PC/80910—7) A study of depolymerization and crosslinking reactions in coal liquefaction: Seventh quarterly report for the period March 1, 1987 to May 31, 1987. Solomon, P.R.; Serio, M.A.; Deshpande, G.V. (Advanced Fuel Research, Inc., East Hartford, CT (USA)). 1987. Contract FG22-85PC80910. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013438.

The major goal of this program is to characterize the depolymerization and crosslinking reactions of low rank coals and determine how they can be optimized in liquefaction by combining high heating rates with solvent interactions. High heating rates are achieved by using a heated tube reactor where coal is heated at about 20,000°C/sec. Solvent interactions to stabilize depolymerization fragments formed at high heating rates are achieved by: (1) coinjection of a donor solvent into the heated tube reactor, (2) preswelling the coal at elevated temperatures (100°C) and pyrolyzing the swelled coal in the heated grid or heated tube reactors and (3) injecting rapidly preheated coal into a hot solvent. Crosslinking and depolymerization reactions are also being studied by using polymers to simulate the chemistry occurring in coal. The polymers poly(2,5 dihydroxy 1,4 p-xylylene), poly(2,6 dimethyl 1,4 phenylene oxide) and carboxylated poly (2,6 dimethyl 1,4 phenylene oxide) were pyrolyzed in the TG-FTIR. The carboxylated polymer showed an earlier weight loss, higher CO_2 evolution and lower tar and methane evolution than the uncarboxylated polymer. The hydroxyl polymer had a higher H_2O evolution and lower tar and methane evolution than the uncarboxylated polymer. The chars of Pittsburgh (high ash) bituminous oxidized coal formed in the TG-FTIR were analyzed for crosslink densities by swelling the chars in pyridine. The rate and extent of crosslinking (as measured by the relative change in swelling ratio) correlated very well with the concentration of the carboxyl groups in the coal. 10 refs.

42916 (DOE/PC/90528—3) Thermodynamics of coal liquid/solid systems: Quarterly progress report, March 16, 1987 to June 15, 1987. Holder, G.D. (Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering). Aug 1987. Contract FG22-86PC90528. 10p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87013751.

The effluent streams of coal liquefaction processes often contain both liquids and solids (THF or pyridine insolubles). The solids appear to affect the physical properties of these liquids due to the adsorption of the heavy liquid components on the coal surface. The design of liquefaction reactors and separation units is dependent to a great extent on the thermodynamics of these multicomponent, multiphase mixtures. Thermodynamic data for many organic systems have been developed for the petroleum industry. This data, however, is limited to the paraffinic compounds while the liquids produced in coal liquefaction are highly aromatic and may contain heteroatoms such as sulfur, oxygen and nitrogen. An effort to generate data bases for these aromatic compounds has been recently made. One of the goals of this work is to expand the data bases so that the properties of coal liquefaction products are accurately determined. The effort to develop data bases for coal liquefaction products has three basic components: (1) pure component physical properties, such as boiling point, critical temperature and pressure, acentric factor, molecular weight and specific gravity and polarity; (2) binary vapor pressure data which enables phase behavior to be calculated for binary and, assuming the interaction of unlike molecules are independent of the presence of a third species, multicomponent systems; (3) vapor pressures of solid-liquid systems as a function of the solids content. This allows the effect that solids have on the distribution of liquids between phases to be calculated. Equilibrium studies of binary and multicomponent aromatic systems are currently conducted in order to quantify the effect of coal solids on the vapor pressure of these systems. Both light and heavy model compounds with and without solids present are used. Actual coal liquids are also examined. 21 refs.

42917 **(DOE/PC/90910—3) Enhanced coal liquefaction by low-severity catalytic reactions: Technical progress report for the period March to May 1987.** Davis, A.; Derbyshire, F.J.; Schobert, H.H. (Pennsylvania State Univ., University Park (USA)). Jun 1987. Contract FG22-86PC90910. 38p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013282.

The objective of this investigation is to examine the potential and limitations of temperature-staged catalytic liquefaction. Experiments have been planned to examine the chemical reactions which occur during the low- and high-severity stages, the effects of coal rank and process conditions, the function of catalyst and influence of solvent donor capability. In our dry, catalytic experiments the key to high conversions is the use of hydrogen at 425°C. Pretreatment with nitrogen gave essentially no advantage, and with hydrogen resulted in a slight improvement in oil yield. For the non-catalytic reactions, with a solvent, the result demonstrates the importance of a hydrogen donor (tetralin compared to naphthalene). The use of hydrogen in the pretreatment stage has little influence on the total level of conversion, but gives a somewhat better oil-asphaltene ratio. In fact, regardless of whether a hydrogen donor is present, the best oil/asphaltene ratios were always obtained whenever hydrogen was used in the first stage and nitrogen in the second stage. In order to understand what kinds of bonds are broken during a low-temperature stage in the presence of a hydrogenation catalyst, five model compounds have been reacted and evaluated in terms of product yield and boiling point distribution. For the reactions conducted at 275°C, biphenyl was found to be unreactive, even in the presence of a catalyst; pyrene, diphenyl ketone and phenyl ether are relatively reactive under these conditions. Temperature-staging with MoS_2 as the catalyst, for most of the model compounds, resulted in more products with boiling points below the starting material, than with any other conditions employed. Observations were made which suggest that minerals can act as catalysts during "non-catalytic runs". 12 refs.

42918 **(LBL—23147) Fundamental studies of catalytic gasification: Quarterly report, January 1, 1987-March 31, 1987.** Heinemann, H. (Lawrence Berkeley Lab., CA (USA)). Mar 1987. Contract AC03-76SF00098. 62p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87013972.

The gasification of graphite by H_2O vapor, wet H_2 and wet O_2, catalyzed by a Ni/K mixture has been studied using controlled atmosphere electron microscopy (CAEM). In H_2O vapor the carbon consumption, between 550 and 1100 C, is catalyzed by an edge recession mode of attack in the [1120] direction, with no sign of deactivation. In wet H_2 both channeling and edge recession occur simultaneously. The activation energy obtained was equal to 30 +- 2 Kcal/mol. The catalyst deactivates above 1000 C, but can be regenerated by treating the sample in H_2O vapor at 600 C. In wet O_2, graphite is also gasified by edge recession, but no preferred direction was observed. The catalyst maintains its activity up to 1000 C, and an activation energy of 25 +- 2 Kcal/mol was obtained. These results show that the catalytic properties of the Ni/K mixture are superior to those of Ni and K alone due to a cooperative effect between the components. The kinetic properties of a catalyst derived from a mixture of KOH and $Ni(NO_3)_2$ for steam gasification of three chars are presented. H_2, CO_2 and small amounts of CO and CH_4 are the reaction products. The product distribution is controlled by the activation energies for formation of the gases. The activation energies for H_2 and CO_2 formation are 29 and 36 Kcal/mol respectively. The catalyst derived from the KOH/$Ni(NO_3)_2$ mixture has better catalytic properties, due to a cooperative effect between nickel and potassium, than catalyst derived by loading the components alone. The mixture has a higher activity and lower activation energies for H_2 and CO_2 production than KOH alone, and higher resistance to deactivation than $Ni(NO_3)_2$ alone. Since char and graphite gasification have the same activation energies, it is concluded that there is a common mechanism for their gasification catalyzed by the KOH/$Ni(NO_3)_2$ mixture. 31 refs., 18 figs., 3 tabs.

42919 **(LBL—23649) Fundamental studies of catalytic gasification: Quarterly report, April 1, 1987-June 30, 1987.** Heinemann, H. (Lawrence Berkeley Lab., CA (USA)). Jul 1987. Contract AC03-76SF00098. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013963.

Our results indicate that there is a strong interaction between nickel and potassium in the steam gasification of carbon solids leading to a ternary oxide compound formation. Nickel and potassium, however, can potentially also interact with other components present in the char, mainly calcium and alumino-silicate compounds. We have previously reported that the nickel/calcium mixed catalysts are much less active than the nickel/potassium mixture for steam gasification of graphite. The nickel/calcium interaction may therefore be a reason for the loss of catalyst activity. Most of the ash components in the char can be extracted by treatment in aqua regia, and this treatment does prevent the loss of catalyst activity with carbon conversion. The same treatment, however, may also affect the char structure and composition, which in turn can be responsible for the results observed. For example, this treatment strongly oxidizes the carbon surface, and the resulting surface oxygen groups may interact with the catalysts, changing their spreading characteristics and thereby the deactivation process. To distinguish between these two possibilities for catalyst deactivation, that is, interaction with the indigenous components of the char, or change of carbon-catalyst contact, further experiments are being performed. First, pretreatment of the char in HF, instead of aqua regia, can extract the mineral content of the char without oxidizing the carbon surface. Comparison of the results obtained after these two pretreatments can distinguish between these two possible explanations for the catalyst deactivation.

42920 **(PB—87-199832/XAB) Journal of the National Chemical Laboratory for Industry, Vol. 81, No. 11, November 1986.** (National Chemical Lab. for Industry, Yatabe, Ibaraki (Japan)). 1986. 124p. NTIS, PC PC E05/MF E01.

Text in Japanese with English abstracts. See also PB—87-199840.

Contents include: role and characteristics of catalyst for coal liquefaction; hydrocracking of extracts from coal-derived liquid; formation and secondary decomposition of n-paraffins in coal liquefaction; hydrotreating of coal liquid derived from wandoan coal by use of Co-Mo and Ni-Mo-Al_2O_3 catalysts; effects of pore-size distribution on the catalytic performance for coal liquefaction; support effects on hydrocracking and hydrogenation activities of molybdenum catalysts used for upgrading coal-derived liquids; a basic engineering study on coal-liquefaction reactions (Part 1), mixing and mass transfer effects in a three-phase fluidized-bed reactor; a basic engineering study on coal-liquefaction reactions (Part 2), properties of coal liquids under the liquefaction conditions; a basic engineering study on coal-liquefaction reactions (Part 3), mass-transfer characteristics of a c.s.t. reactor under liquefaction conditions; a basic engineering study on coal-liquefaction conditions (Part 4), effect of solvent recycling; a basic engineering study on coal-liquefaction reactions (Part 5), heat of reaction for coal liquefaction.

42921 **(PB—87-199857/XAB) Journal of the National Chemical Laboratory for Industry, Vol. 82, No. 1, January 1987.** (National Chemical Lab. for Industry, Yatabe, Ibaraki (Japan)). 1987. 72p. NTIS, PC PC E04/MF E01.

Text in Japanese with English abstracts. See also PB—87-149225.

Contents include: study on behavior of catalyst and solvent in coal liquefaction (Part 2), recycle effect of the solvent in single-stage liquefaction with a nickel-molybdena-alumina catalyst; study on behavior of catalyst and solvent in coal liquefaction (Part 3), effect of the composition of recycle solvent on the performance of single-stage liquefaction; study on behavior of catalyst and solvent in coal liquefaction (Part 4), study of two-stage liquefaction with thf-soluable solvent; analysis of initial solvent and product oil in coal liquefaction (Part 1), gas chromatographic analysis of anthracene oil; analysis of initial solvent and product oil in coal liquefaction (Part 2), gas chromatographic analysis of hydrogenated anthracene oil; analysis of initial solvent and product oil in coal liquefaction (Part 3), analysis of distillable fraction in liquefaction product; analysis of initial solvent and product oil in coal liquefaction (Part 4), comparison of residual products from brown coal and subbituminous coal.

42922 **(UCRL—96461) Further development of an axisymmetric global UCG [underground coal gasification] cavity growth simulator.** Britten, J.A.; Thorsness, C.B. (Lawrence Livermore National Lab., CA (USA)). 15 Jul 1987. Contract W-7405-ENG-48. 13p. (CONF-8708106—2). NTIS, PC A02. File Number DE87013115.

From 13. annual underground coal gasification symposium; Laramie, WY, USA (24 Aug 1987).

Development has continued on the global underground coal gasification (UCG) cavity simulation model CAVSMII, first described at the 12th UCG symposium, with the result that it now treats essentially all major processes that occur during a UCG operation. To a large extent these modifications were motivated by insight into UCG cavity growth gained from observation of the excavated Partial Seam CRIP (PSC) UCG site. A submodel for water influx has been formulated and added, based on gravity drainage and water reflux, including compressibility effects of the medium. A submodel empirically describing the growth of an outflow channel from a horizontal uncased production borehole in the coal seam has been developed as well. The settling of solids in the rubble pile caused by removal of carbon from spalled char has been reformulated more realistically. Another major modeling reformulation is the addition of a resistance to gas flow through the overburden rubble, which was previously assumed negligible in comparison to the ash pile flow resistance. Also, the submodel describing dynamics of the reaction zone between the ash rubble and the competent coal wall, which previously consisted of an empirical two-parameter model, is now fully integrated into the global cavity evolution model and solved for each time step. At the same time, more efficient algorithms for computing flow of injection gas through the rubble pile have reduced both total CPU time and code memory requirements by more than a factor of two. The present state of the simulator is presented and the effect of some key physical and process parameters is explored. Finally, results are presented for the simulation of UCG cavity growth for the PSC test, the upcoming Rocky Mountain I test and a test of a high-ash, relatively thin seam coal proposed for Brazil. 13 refs.

42923 **(UCRL—96464) A simple UCG [underground coal gasification] field performance and economics model.** Cena, R.J. (Lawrence Livermore National Lab., CA (USA)). 5 Aug 1987. Contract W-7405-ENG-48. 14p. (CONF-8708106—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013794.

From 13. annual underground coal gasification symposium; Laramie, WY, USA (24 Aug 1987).

Lawrence Livermore National Laboratory, over the past decade, has studied the technical feasibility of underground coal gasification through a combination of field tests, laboratory experiments and mathematical models. In 1979, Thorsness and Cena developed EQSC, a simple equilibrium model to correlate field results. In the model, water influx into the reaction zone and heat loss to the surroundings, coupled with a water-gas-shift equilibrium assumption governing the composition of gas leaving the reaction zone, were found to be major contributors in determining UCG performance, consistent with field results. Recently, EQSC has been expanded to calculate plant capacity and estimate capital and operating costs for producing one of several products for a specific UCG site. The model provides a simple framework for comparing the relative impact of many site specific parameters affecting UCG performance, consistent with material and energy balance constraints, implicit in the model. In this paper, the EQSC model is described along with a parametric study of UCG performance and costs for a variety of cases. 3 refs., 11 figs., 8 tabs.

42924 **(UCRL—97203) Unconfined flow as a mechanism of water influx to a UCG [underground coal gasification] system.** Thorsness, C.B.; Grens, E.A. II. (Lawrence Livermore National Lab., CA (USA); California Univ., Berkeley (USA). Dept. of Chemical Engineering). 6 Aug 1987. Contract W-7405-ENG-48. 12p. (CONF-8708106—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013793.

From 13. annual underground coal gasification symposium; Laramie, WY, USA (24 Aug 1987).

Water influx to an operating underground coal gasification (UCG) cavity plays a major role in determining the success of the process. Often coal seams are aquifers, and as a result water influx estimates for a UCG cavity need to consider the flow of water from the coal to the cavity. Since the gasification cavity is gas filled, the flow takes place in the presence of a developing phreatic (free surface) separating the water saturated portion of the seam from the expanding unsaturated region. In this paper results are presented for water influx calculations for several geometries with phreatic surfaces related to UCG systems. Numerical solutions of the defining equations are compared to solutions obtained for simplified equation sets resulting from the application of the Dupuit approximation. Such approximate solutions appear to be adequate during initial transients and are more amenable to incorporation in global UCG models. Consideration is given to the influence of geometry, permeability, porosity, formation compressibility and the motion of cavity walls. In addition to general results, specific estimates of water influx for the upcoming Rocky Moutain I test are reported. 5 refs., 16 figs., 1 tab.

42925 **Low-severity coal liquefaction: A challenge to coal structure dependency.** Moroni, E.C. (US Dept. of Energy, FE-34 GTN, Washington, DC 20545). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **31**: No. 4, 1-4(Sep 1986). (CONF-860911—).

From 192. American Chemical Society national meeting; Anaheim, CA, USA (7 Sep 1986).

The purpose of this paper is to summarize recent information from coal liquefaction studies in bench scale as well as in integrated process development units, together with the data from new analytical techniques which have provided substantial amounts of new information on several important aspects of coal structure and coal reactivity. The results of these studies reveal that existing coal models and current empirical tests for coal reactivity no longer reflect adequately the new knowledge of coal structure and coal reactivity.

42926 **Thermal effects on liquefaction of Kentucky #9 coal with NiMo/Al/sub 2/O/sub 3/ catalyst.** Kwon, K.C. (Chemical Engineering Dept., Tuskegee Univ., Tuskegee, AL 36088). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **31**: No. 4, 24-31(Sep 1986). (CONF-860911—).

From 192. American Chemical Society national meeting; Anaheim, CA, USA (7 Sep 1986).

The main objectives of this research are to investigate effects of heating rates on deactivation of catalysts, to identify interactions between hydrogen donor solvents (HDS) and catalysts, to study effects of initial temperatures on catalytic activities, and to elucidate interactions between physical solvents and catalytic activities in the early stage of coal liquefaction.

42927 **Moderate temperature coal hydrogenation.** Skowronski, R.P.; Heredy, L.A. (Rockwell International, Rocketdyne Div., 6633 Canoga Avenue, Canoga Park, CA 91304). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **31**: No. 4, 32-38(Sep 1986). (CONF-860911—).

From 192. American Chemical Society national meeting; Anaheim, CA, USA (7 Sep 1986).

Hydroliquefaction of two bituminous coals was explored to obtain information on the chemistry of liquefaction. Tests were conducted in the temperature range of 275 to 325°C and at 20.7 MPa hydrogen pressure. No donor solvent was added to the reactant to simplify product analysis and the evaluation of the results. The results and conclusions are summarized below: 1. Exploratory tests showed that at a liquefaction temperature of 325°C, high conversion to oil can be obtained with few side reactions resulting in gas or coke formation. 2. Of the two bituminous coals tested, the lower rank coal (C = 80%) was much more reactive and gave 50% higher oil yield than the higher rank coal. 3. It was shown in experiments made with the higher rank coal that the metal components of the autoclave (linear and impeller) had a strong catalytic effect on the liquefaction reaction. 4. Catalysis by nickel, applied as nickel acetate impregnated into the coal, gave significantly different results from those obtained in the metal-lined reactor. Overall conversion to soluble products was higher using the nickel catalyst (94% versus 87%). However, nickel catalysis gave lower conversion to oil (40% versus 48%). 5. The oil produced in the nickel-

catalyzed hydrogenation was significantly more aliphatic in character than the product from the metal-surface catalyzed reactions.

42928 **Extraction of low-rank coals with supercritical water.** Swanson, M.L.; Olson, E.S.; Diehl, J.W.; Farnum, S.A. (Univ. of North Dakota Energy Research Center, Box 8213, University Station, Grand Forks, ND 58202). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **31**: No. 4, 43-55(Sep 1986). (CONF-860911—).

From 192. American Chemical Society national meeting; Anaheim, CA, USA (7 Sep 1986).

Supercritical water extractions were performed on low-rank coals utilizing a semicontinuous supercritical solvent extraction system. The objective of this research was to investigate the use of water as a cheap supercritical extraction solvent for obtaining environmentally acceptable liquid fuels and chemical feedstocks from coal and attempt to use supercritical solvent extraction as a means for determining the composition of various molecular fractions present in low-rank coals.

42929 **Reactions of coal and coal model compounds with supercritical water.** Mikita, M.A.; Fish, H.T. (Univ. of Colorado at Denver, Dept. of Chemistry, Denver, CO 80202). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **31**: No. 4, 56-63(Sep 1986). (CONF-860911—).

From 192. American Chemical Society national meeting; Anaheim, CA, USA (7 Sep 1986).

The objective of this study was to initiate an investigation into the organic reaction mechanisms of coal and coal model compounds with supercritical water. A multireactor consisting of five individual microautoclaves, each of approximately 45-mL capacity and attached to a single yoke, was used to study these reactions. For all experiments reported here, the reactors, once pressurized, were isolated from the gas-handling manifold by a valve and a short length of tubing of negligible volume. This prevented loss of water from the reaction zone due to condensation in the unheated portion of the system. Separate experiments using different reactors, in which it was possible for water to migrate to unheated regions of the system, indicated that such water loss had a profound but erratic effect on measured values for pressure and coal conversion, and generally led to misleading data.

42930 **Reactions of low-rank coals in supercritical methanol.** Olson, E.S.; Swanson, M.L.; Olson, S.H.; Diehl, J.W. (Univ. of North Dakota Energy Research Center, Box 8213, University Station, Grand Forks, ND 58202). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **31**: No. 4, 64-69(Sep 1986). (CONF-860911—).

From 192. American Chemical Society national meeting; Anaheim, CA, USA (7 Sep 1986).

Supercritical fluid extraction of coals has been investigated as a promising method for the production of liquid fuel products from coal under mild conditions. As a part of this study of the interaction of supercritical solvents with low-rank coals, a series of extractions of lignites and subbituminous coals were performed with supercritical methanol in a semi continuous extraction apparatus. These studies were concerned with establishing yield and conversion data for several coals at various supercritical conditions. Not only can the solvation power of the solvent (which depends on the fluid density) be conveniently controlled over a large range with changes in solvent pressure or temperature, but the rates of chemical reactions occurring in and with the solvent may also be controlled by the wide variation in viscosity and density which are obtained with supercritical fluids.

42931 **The chemcoal process for low temperature conversion.** Porter, C.R.; Knudson, C.L.; Rindt, J.R. (Carbon Resources, Inc., 4892 Independence St., Suite 130, Wheat Ridge, CO 80033). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **31**: No. 4, 70-76(Sep 1986). (CONF-860911—).

From 192. American Chemical Society national meeting; Anaheim, CA, USA (7 Sep 1986).

The ChemCoal Process utilizes chemical means to transform coal and other carbonaceous materials to solid, liquid, and slurry products. The process uses coal-derived solvents and aqueous alkali to dissolve and breakdown carbonaceous materials. Carbon monoxide is used to generate hydrogen via the water has shift reaction to cap organic species. Insoluble sulfur and ash impurities are separated from the soluble organic fraction. Recycle solvent, light oils, alkali, and water are extracted from the soluble fraction and preasphaltenes (PA) and asphaltenes (A) are precipitated by the addition of methanol. The precipitated PA and A, the ChemCoal solid products, have been slurried and used in a diesel engine. The methanol fraction is processed to recovery recycle solvent, alkali, water, light oils, and methanol. The process has been evaluated under continuous process, operation at the University of North Dakota Energy Research Center (UNDERC).

42932 **The direct use of natural gas in coal liquefaction.** Sundaram, M.S.; Steinberg, M. (Process Sciences Div., Brookhaven National Lab., Upton, NY 11973). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **31**: No. 4, 77-84(Sep 1986). (CONF-860911—). Contract AC02-76CH00016.

From 192. American Chemical Society national meeting; Anaheim, CA, USA (7 Sep 1986).

The main objective in coal liquefaction is to convert coal into a better fuel that is easier to transport and cleaner to burn. During the liquefaction process, the macromolecular network of coal substance is broken into smaller units and rearranged into lighter products of reduced molecular weight. More specifically, the chemical conversion of coal involves an upgrading in its hydrogen content or in other words, increasing the H/C ratio. A comparative assessment of the performance of the coal-methane system with the coal-hydrogen system under nominal liquefaction conditions, in various solvents, will be an important contribution to the emerging coal liquefaction science and technology. This study could lead to the development of alternate, new and economically attractive coal liquefaction processes.

42933 **The roles and importance of hydrogen donation and catalysis in coprocessing.** Curtis, C.W.; Cassell, F.W.; Cahela, D.R. (Chemical Engineering Dept., Auburn Univ., AL 36849). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **31**: No. 4, 161-168(Sep 1986). (CONF-860911—).

From 192. American Chemical Society national meeting; Anaheim, CA, USA (7 Sep 1986).

The objective of the current work is to investigate the effect of hydrogen donor addition in conjunction with catalytic hydrotreatment on the products obtained from upgrading residuum and coprocessing coal with petroleum residuum. The reaction products are evaluated in terms of solubility fractions, coal conversion to solubles in the solvent extraction scheme used and oil production. Oil production is defined as the amount of pentane solubles after reaction minus the initial pentane solubles divided by the upgradeable materials which are the pentane insoluble materials from maf coal and the residuum. In addition, the amount of hydrogen transferred to the products via gas-phase molecular hydrogen and donation by hydrogen donors is examined. The efficacy of donable hydrogen in promoting coal conversion and producing a high quality product slate is evaluated in thermal and catalytic coprocessing.

42934 **Single-stage slurry catalyzed co-processing.** Gatsis, J.G. (Signal Research Center Inc., Box 5016, Des Plaines, IL 60017-5016). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **31**: No. 4, 181-191(Sep 1986). (CONF-860911—).

From 192. American Chemical Society national meeting; Anaheim, CA, USA (7 Sep 1986).

The single-stage, slurry-catalyzed Co-processing concept was successfully demonstrated in laboratory batch experiments. The active UOP catalyst gave high coal conversion and high conversion to liquid product at relatively low temperature and, as a result, thermal degradation reactions and cracking of resid- and coal-derived liquid to light gases were minimized. The liquid hydrocarbon product is of high quality and can be efficiently utilized as a feedstock in existing refineries. The continuous bench-scale operation gave similar performance to the laboratory batch experiments, satisfying the proof-of-concept objective. In addition, data generated to date initiate a firm experimental basis on which to evaluate a con-

ceptual commercial facility. These data show that the Co-processing process is sensitive to high severity conditions (temperature, residence time). High coal conversion and high conversion to high quality liquid product can be achieved by operating at relatively mild conditions where thermal degradation reactions are minimized.

42935 **Coal liquefaction/resid hydrocracking via two-stage integrated co-processing.** Greene, M.; Gupta, A.; Moon, W. (Lummus Crest Inc., 1515 Broad Street, Bloomfield, NJ 07003). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **31**: No. 4, 208-215(Sep 1986). (CONF-860911—).

From 192. American Chemical Society national meeting; Anaheim, CA, USA (7 Sep 1986).

Lummus Crest Inc. (LCI), a subsidiary of Combustion Engineering Inc., has been developing technology for the simultaneous processing of coal and heavy petroleum liquids under a joint development contract with the U.S. Department of Energy. The project was formulated into five major program tasks: 1: Project Management Plan; 2: Feedstock Analysis; 3: Co-Processing Reactivity Screening; 4: Continuous Bench-Scale Operations; 5: Cost Estimate of Conceptual Commercial Facility. The first three tasks have been completed and the continuous Bench-Scale Operations task has recently been initiated. This paper describes experimental methods, the LCI co-processing approach and the results of recent bench-scale unit operations.

42936 **Simulation of a coal/petroleum resid coprocessing pilot plant scheme.** Pukanic, G.W.; Smith, D.N.; Ruether, J.A. (US Dept. of Energy, Pittsburgh Energy Technology Center, Pittsburgh, PA 15236). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **31**: No. 4, 216-226(Sep 1986). (CONF-860911—).

From 192. American Chemical Society national meeting; Anaheim, CA, USA (7 Sep 1986).

Coprocessing involves the conversion of coal and heavy oil in the presence of hydrogen to products that can be further upgraded into commercial fuels; the upgrading can be carried out in an existing refining operation. This relatively new concept eliminates or significantly reduces the need for expensive solvent recycle, and thus has the potential for improved economic performance over current direct coal liquefaction processes. A simulation of a single-stage coprocessing pilot plant involving the simultaneous conversion of resid and coal has been carried out using the ASPEN PLUS simulator. Limited experimental data were available for only one run, and results should be considered preliminary. For some process equipment, petroleum liquids correlations are better than coal liquids correlations. Testing for the presence of a free water phase and the treatment of heavy resid as a single high-boiling pseudo-component has improved simulator performance.

42937 **An assessment of the potential for coal/residual oil coprocessing.** Huber, D.A.; Lee, Q.; Thomas, R.L.; Frye, K.; Rudins, G. (Burns and Roe, Oradell, NJ 07649). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **31**: No. 4, 227-232(Sep 1986). (CONF-860911—).

From 192. American Chemical Society national meeting; Anaheim, CA, USA (7 Sep 1986).

Among the promising new techniques to produce liquid hydrocarbon fuels from coal is coal/petroleum coprocessing based upon the use of heavy oil, tar sand bitumen and petroleum residua as "solvents" for the conversion of coal. Coprocessing is the simultaneous hydrogenation of coal and heavy oil fractions in specially designed reactors with coal contents by weight ranging from as low as 1% to potentially as high as 50-60% depending upon the technology employed. The results of a study on the potential for coal/residual oil coprocessing in the United States are addressed in this paper.

42938 **Chemical and toxicologic characterization of co-processing and two-stage direct coal liquefaction materials.** Wright, C.W.; Stewart, D.L.; Mahlum, D.D.; Chess, E.K.; Wilson, B.W. (Pacific Northwest Lab., P.O. Box 999, Richland, WA 99352). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **31**: No. 4, 233-239(Sep 1986). (CONF-860911—). Contract AC06-76RL01830.

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Recent advances in coal liquefaction have included two-stage direct coal liquefaction processes and petroleum resid/coal co-processing technology. Two-stage coal liquefaction processes are generally comprised of a first-stage thermal or liquefaction reactor followed by a second-stage hydrogenation step. Petroleum resids and coal are simultaneously converted to liquefaction products in co-processing technology. The purpose of this paper is to report the preliminary results of the chemical analysis and toxicological testing of a coal liquefaction co-processing sample set, and to compare these results to those obtained from two-stage coal liquefaction materials.

42939 **Process development studies of two-stage liquefaction at Wilsonville.** Lamb, C.W.; Nalitham, R.V.; Johnson, T.W. (Catalytic, Inc., Wilsonville, AL 35186). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **31**: No. 4, 240-250(Sep 1986). (CONF-860911—).

From 192. American Chemical Society national meeting; Anaheim, CA, USA (7 Sep 1986).

The Advanced Coal Liquefaction R and D Facility at Wilsonville, Alabama, has been in operation for over 12 years. It is the largest direct coal liquefaction pilot plant still in operation in the United States. Process investigations have evolved from the original study of the Solvent Refined Coal Process for making a clean solid fuel to the recent investigation of two-stage liquefaction processes for making clean distillate fuels. This paper presents results from the current study of various processing schemes designed to reduce the cost of fuels produced by two-stage liquefaction plants.

42940 **Improvement in coal liquefaction solvent quality by dewaxing.** Winschel, R.A.; Robbins, G.A.; Burke, F.P. (Conoco Coal Research Div., 4000 Brownsville Road, Library, PA 15129). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **31**: No. 4, 257-267(Sep 1986). (CONF-860911—).

From 192. American Chemical Society national meeting; Anaheim, CA, USA (7 Sep 1986).

Recycle oils from the Integrated Two-Stage Liquefaction (ITSL), H-Coal and Solvent Refined Coal (SRC) processes were dewaxed by variants of commercial dewaxing processes. Dewaxing methods used include the ketone and the urea adduction techniques. The clean waxes are reasonably pure paraffins. The dewaxed oils were substantially better coal liquefaction solvents than the original (non-dewaxed) oils in batch liquefaction tests. These data provide a direct indication of the inimical effect of paraffinic components on solvent quality. The impact of solvent quality is particularly relevant to two-stage liquefaction, in which thermal first-stage reactions proceed in a recycle solvent.

42941 **Performance of the low temperature first stage of HRI's catalytic two-stage liquefaction process.** Mc Lean, J.B.; Comolli, A.G.; Smith, T.O. (Hydrocarbon Research, Inc. (A Subsidiary of Dynalectron Corp.), P.O. Box 6047, Lawrenceville, NJ 08648). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **31**: No. 4, 268-279(Sep 1986). (CONF-860911—).

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Hydrocarbon Research, Inc. (HRI), under the sponsorship of the U.S. Department of Energy (DOE), is developing a catalytic two-stage coal liquefaction process. The process consists of two direct-coupled ebullated-bed reactors in series, with the first stage operated at lower temperatures ($<800^{\circ}F$) than typically used in direct liquefaction. Studies of both bituminous and sub-bituminous coals in a nominal 50 lb/day continuous, integrated recycle bench unit have shown considerable improvements in both distillate yield and product quality over other processes. In order to better understand the chemistry of the unique first-stage reactor conditions, a special on-line sampling system was added to the bench unit.

42942 **Transportation fuels from two-stage liquefaction products.** Sullivan, R.F. (Chevron Research Co., P.O. Box 1627, Richmond, CA 94802-0627). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **31**: No. 4, 280-293(Sep 1986). (CONF-860911—).

From 192. American Chemical Society national meeting; Anaheim, CA, USA (7 Sep 1986).

The purpose of this paper is to compare results for syncrudes from single-stage and two-stage processes, from different two-stage processes, from different coals and of different boiling ranges from a given coal and process. In this paper, the authors will use results for upgrading products from the H-Coal process as the primary basis for comparison with single-stage processes.

42943 **Integrated two-stage liquefaction: The legacy and the unfinished work.** Moroni, E.C. (U.S. Dept. of Energy, FE-34 GTN, Washington, DC 20545). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **31**: No. 4, 294-299(Sep 1986). (CONF-860911—).

From 192. American Chemical Society national meeting; Anaheim, CA, USA (7 Sep 1986).

The Integrated Two-Stage Liquefaction (ITSL) concept has received considerable attention by many laboratories and has emerged as one of the most promising technology in direct coal liquefaction. This paper has the objective to divulge the most recent achievements of an evolved ITSL process, pointing out the unfinished work, and to expand the concept of the low-severity staged approach which resulted from the evolved ITSL process and emerged as the most desirable pathway for the direct production of marketable liquid fuels from coals. The ultimate objective is to interest the researchers dedicated to fundamentals of coal liquefaction toward the technological needs and the understanding of reaction mechanism, kinetics and thermodynamic limitations residing with the novel, low-severity staged coal liquefaction approach.

42944 **Temperature-staged catalytic coal liquefaction.** Derbyshire, F.; Davis, A.; Epstein, M.; Stansberry, P. (College of Earth and Mineral Sciences, The Pennsylvania State Univ., University Park, PA 16802). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **31**: No. 4, 308-313(Sep 1986). (CONF-860911—).

From 192. American Chemical Society national meeting; Anaheim, CA, USA (7 Sep 1986).

In some earlier reported research a bituminous and a subbituminous coal were pretreated by dry catalytic hydrogenation, using a molybdenum catalyst at 350°C for 1 h, following which they were mixed with naphthalene (2:1 solvent to coal ratio) and reacted at 425°C for 10 min. The results showed that the low-temperature pretreatment improved both the net coal conversion, based upon solubility in tetrahyrofuran, and the product distribution. Notably, the oil to asphaltene ratio was substantially increased with only marginal additional gas make. Based upon these findings, further research has been directed to investigating the chemistry and the potential of temperature-staged coal liquefaction. The results of this research are presented in this paper. Similar studies are being conducted on a larger scale by Hydrocarbon Research Inc.

42945 **Two-stage coal liquefaction without gas-phase hydrogen.** Stephens, H.P. (Sandia National Labs., Albuquerque, NM 87185). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **31**: No. 4, 314-320(Sep 1986). (CONF-860911—). Contract AC04-76DP00789.

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The results of the experiments presented in this paper clearly demonstrate that coal can be effectively liquified without the use of high-pressure purified hydrogen feed gas. This suggests that substantial economic improvements in direct coal liquefaction can be achieved.

42946 **The effect of reaction conditions on solvent loss during coal liquefaction.** Utz, B.R.; Friedman, S. (U.S. Dept. of Energy, Pittsburgh Energy Technology Center, P.O. Box 10940, Pittsburgh, PA 15236). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **31**: No. 4, 331-335(Sep 1986). (CONF-860911—).

From 192. American Chemical Society national meeting; Anaheim, CA, USA (7 Sep 1986).

The use of a one-component solvent system can be misleading because reactions with coal may be occurring that normally would not occur if other components of a solvent were present. The objective of this study was to examine a multicomponent synthetic solvent and determine if solvent components are preferentially lost or degraded during short-contact-time liquefaction (SCTL), and how solvent loss in SCTL compares with other liquefaction conditions that involve gradual heat-up. The effect of reaction conditions on solvent loss was determined. Solvent recovery and solvent balance were better than expected for SCTL and traditional liquefaction conditions. Surprisingly, very little adduction of solvent components was observed. Increased severity of reaction conditions caused an increase in degradation of the synthetic solvent and an increase in adduction (approximately 2.5%). From these results, the extent of solvent adduction under most liquefaction conditions is minimal, and the solvent quality is most affected because of increased degradation with increasing severity.

0105 By-products

REFER ALSO TO CITATION(S) 42964, 44034

42947 **(PB—87-201471/XAB) Mix proportioning of concrete containing fly ash for highway applications. Final report.** Carrasquillo, P.M.; Tikalsky, P.J.; Carrasquillo, R.L. (Texas Univ., Austin (USA). Center for Transportation Research). May 1986. 55p. (CTR—3-9-84-364-4F). NTIS, PC A04/MF A01.

The need for more cost-efficient construction materials for use in highway construction and the problem of waste disposal of fly ash have prompted the study reported herein. The study addresses the major concerns of resident highway engineers about concrete containing fly ash for highway applications, which include: curing conditions, strength development, durability, materials selection, and mix proportioning. The report summarizes the proposed trial mix design procedure for concrete containing fly ash developed by the Texas State Department of Highways and Public Transportation.

0106 Properties

REFER ALSO TO CITATION(S) 42914, 42915, 42973, 43650

42948 **(DOE/PC/79863—T3) High-sulfur coal research at the SIUC Coal Technology Laboratory: Quarterly progress report, May 9, 1987-July 17, 1987.** (Southern Illinois Univ., Carbondale (USA). Coal Extraction and Utilization Research Center). 1987. Contract FC22-87PC79863. 143p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87013461.

Research on high-sulfur coal which is taking place at the Coal Technology Laboratory at Southern Illinois University at Carbondale is divided into four general categories: coal science, coal preparation, coal conversion, and coal utilization. The work in these four areas covers a broad spectrum of high-sulfur coal research from the very fundamental aspects of the coal, through its physical beneficiation and possible conversion, to its ultimate utilization and overall economic modeling. The project performing a model analysis of sulfur reduction technology and sulfur emission limitations involves a coal supply and transportation model developed in prior years. The results of recent model runs indicate that, in the absence of new SO_2 regulations, only a modest impact can be expected on the coal market pattern by assuming coal contracts. An experimental pulse combustor test rig has been fabricated and instrumented for the project examining fine-particle coal as a source of energy in small-user applications. The influence of fuel/air mixing on combustor performance was evaluated this quarter. In the final project in the coal utilization area, involving the spontaneous combustion of coal and maceral-enriched fractions under storage and pneumatic transport conditions, cutinite was the most reactive to oxygen at low temperature, followed in decreasing order of activity by sporinite, vitrinite, and semifusinite. The reactivity and

activation energy of the low-temperature oxidation of macerals may control the potential for spontaneous combustion of coal. A small-scale fluidized bed combustor for space heating has been designed and is now under construction.

42949 **(DOE/PC/90527—T3) Characterization of oxidized coal surfaces: Quarterly report, May 1987-July 1987.** Hercules, D.M. (Pittsburgh Univ., PA (USA). Dept. of Chemistry). 1987. Contract FG22-86PC90527. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013089.

Work has progressed in the areas of (1) exploration or derivatization reactions for ambient temperature in-situ derivatization of aldehydes, ketones, and phenols on carbon surfaces; (2) analysis of these derivatives by secondary ion mass spectrometry (SIMS) and laser mass spectrometry (LMS); (3) derivatization and analysis of a naturally weathered coal; (4) construction of a reactor for controlled low temperature oxidation of coal; and (5) design of a protocol for handling coal samples. Specific derivatization reactions studied in this period included reactions of Girard's reagent, 2,4-dinitrophenylhydrazine and bisulfite with aldehydes and ketones and 4-triethylammonium-2-butene (TAB), trimethylsilyl ethers (TMS) and dimethylsilyl ethers (DMS) with phenols and alcohols. Positive ion SIMS analysis of Girard's reagent derivatives and TAB derivatives on a silver support yielded molecular ion species (e.g., cations from the salts) for a wide range of carbonyl and phenolic compounds, respectively. Comparison of negative ion LMS spectra of naturally weathered Illinois No. 6 coal before and after treatment with 2,4-dinitrophenylhydrazine reveals the presence of two high mass ions in the spectrum of treated coal that are not present in the spectra of either the untreated coal or the derivatizing reagent. This provides both evidence for carbonyl functionality on the surface of naturally weathered Illinois No. 6 coal and support for the feasibility of in-situ derivatization and analysis of organic components in the coal matrix. 5 refs.

42950 **(ECN—87-071) Relation between pulverized coal particle size distribution and fly ash quality as a function of coal characteristics and installation performance.** Alderliesten, P.T.; Van der Sloot, H.A.; Plomp, A.; Christophe, J. (Netherlands Energy Research Foundation, Petten). May 1987. 7p. (CONF-871030—6). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

From Coal science international conference; Maastricht, Netherlands (26 Oct 1987).

Fly ash properties depend on particle size and size distribution of pulverized coal, coal characteristics and coal burning installations. In a series of experiments these parameters were tested by burning four different types of coal in coal boilers of the Amer Power Station at Geertruidenberg, Netherlands. Strong correlation is found between the particle size distribution of burnt coal fines and fly ash. Aim of this investigation was to improve fly ash quality, since fly ash finds an extensive use as an additive in concretes for roads, buildings and other constructions.

42951 **(ECN—87-077) Size distribution characteristics of size-graded pulverized coal.** Hoornstra, J.; Dunn-Rankin, D. (Netherlands Energy Research Foundation, Petten). Jun 1987. 6p. (CONF-871030—7). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

From Coal science international conference; Maastricht, Netherlands (26 Oct 1987).

Pulverized coal combustion, including ignition, flame-stability, ash formation, deposition and the characteristics of the formed fly ash, depends on the particle size distribution of the feedstock. In power stations the fineness of the feed coal is expressed as the percentage of product passing through various sizes of sieves according to e.g. ASTM standard D-197. This technique, however, distinguishes only the largest particles in the feedstock, without regard to the entire size distribution. The present work examines how sieve classification affects the entire size distribution, and discusses the usefulness of this classification procedure for studying particle size effects on combustion. 4 figs., 9 refs.

42952 **Isolation and identification of benzoquinolines in natural and synthetic crude oils.** Ma, C.Y.; Ho, C.-H.; Caton, J.E.; Griest, W.H.; Guerin, M.R. (Oak Ridge National Lab., TN). *Fuel;* **66**: No. 5, 612-617(May 1987).

Using a sequential HPLC technique, the levels of the eight benzoquinoline isomers were estimated for two petroleum crude oils, several coal liquids, shale oils and a coal gasifier tar. Significant concentrations (5-420 ppm) of phenanthridine, acridine, benzo(h)quinoline and benzo(f)quinoline were found in all coal-derived materials with the former two isomers being most abundant. In contrast, benzo(g)quinoline, benz(g)isoquinoline, benz(h)isoquinoline and benz(f)isoquinoline were seldom present at levels above 1 ppm. None or trace quantities of the eight isomers were detected in two petroleum crude oil samples. Major benzoquinoline isomers from one coal liquid were individually isolated and the presence of phenanthridine, benzo(h)quinoline and benzo(f)quinoline was unequivocally confirmed by matching infrared spectra. 22 refs., 2 figs., 3 tabs.

42953 **Evidence for C-alkylation in higher rank coals under mildly basic conditions.** Botto, R.E.; Choi, C.Y.; Muntean, J.V.; Stock, L.M. (Argonne National Lab., IL). *Energy and Fuels;* **1**: No. 3, 270-273(May-Jun 1987).

Two high-volatile A bituminous coals were alkylated with ^{13}C-enriched methyl and butyl iodide by using tetrabutylammonium hydroxide as base. Results from elemental analyses suggest that 2.3 +/- 0.2 and 4.8 +/- 0.2 methyl groups have been added to every 100 carbon atoms of PSOC-726 and PSOC-732 coals, respectively. The solid ^{13}C NMR spectra of the methylated coals show that about 20-30% of the methyl groups have reacted with functional groups other than hydroxyl or carboxyl groups. The chemical shift evidence is most compatible with alkylation occurring predominantly on acidic carbon centers in derivatives of fluorene, indene, phenalene, and benzanthrene rather than on nitrogen or sulfur functional groups. 29 refs., 3 figs., 2 tabs.

42954 **Density separation of alkylated coal macerals.** Choi, C.-Y.; Dyrkacz, G.R.; Stock, L.M. (Argonne National Lab., IL). *Energy and Fuels;* **1**: No. 3, 280-286(May-Jun 1987).

A two-dimensional approach involving chemical alkylation and density gradient centrifugation has been investigated for the separation of coal and its petrographically pure macerals. The approach was tested by the study of two whole bituminous coals and several isopycnic maceral fractions from each of these coals. Alkylation of the whole coal changes the density distribution in a complex way. Alkylation of the individual maceral fractions also changes the distribution. The specific changes are discussed in this report. The density variations that are observed as a consequence of alkylation suggest that isopycnic maceral fractions often contain several particulate constituents. 30 refs., 12 figs., 5 tabs.

42955 **Coal processing in non-dissolving media.** Kaufman, M.; Jamison, W.C.L.; Gandhi, S.; Liotta, D. (Dept. of Chemistry, Emory Univ., Atlanta, GA 30322). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **31**: No. 4, 39-42(Sep 1986). (CONF-860911—).

From 192. American Chemical Society national meeting; Anaheim, CA, USA (7 Sep 1986).

If coal is contacted with an organic reagent in a medium in which the reagent is marginally soluble, there may be a tendency for the reagent to transfer to the pores and surfaces of the coal, where it has maximum utility for reactions which cleave the coal macromolecular network. Thus, in such media it may be possible to employ lower concentrations of reagents than would be required in totally soluble systems. If, in addition, coal fragments are insoluble in the processing medium, the coal particles will be recovered intact after processing. The reagent can then be washed from the coal, and coal conversion assessed as solubility in a standard solvent. Since the reagent is not present when solubility is measured, conversion should be independent of the solvent properties of the reagent, and only dependent on its ability to break bonds during processing.

42956 **Reaction of a bituminous coal with the potassium-crown ether reagent.** Huang, S.; Wood, K.; Narayan, R. (Coal Research Center, Institute for Interdisciplinary Engineering Studies, Purdue Univ., A.A. Potter Engineering Center, West Lafayette, IN 47907). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **31**: No. 4, 85-93(Sep 1986). (CONF-860911—).

From 192. American Chemical Society national meeting; Anaheim, CA, USA (7 Sep 1986).

In this paper, the authors report on the reaction of a bituminous coal with a powerful yet selective site-specific reagent, namely, potassium-crown ether operating at room temperature and atmospheric pressure. The potassium-crown ether reagent can generate a stable solution of electrons at room temperature and atmospheric pressure. The small size of the electron and its high reactivity permits it to diffuse into the macromolecular coal network and transfer onto the aromatic substrates in the coal. This results in the formation of aromatic radical anions or dianions which undergo cleavage reactions at ether and diaryl alkane linkages.

42957 **Mild oxidative solubilization of coal macerals.** Winans, R.E.; Hayatsu, R.; Mc Beth, R.L.; Scott, R.G.; Botto, R.E. (Chemistry Div., Argonne National Lab., 9700 South Cass Avenue, Argonne, IL 60439). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **31**: No. 4, 94-102(Sep 1986). (CONF-860911—). Contract W-31-109-ENG-38.

From 192. American Chemical Society national meeting; Anaheim, CA, USA (7 Sep 1986).

The objective of this study is to solubilize coal macerals and an Argonne Premium Coal Sample using oxidation and to characterize these soluble products. A major problem in coal characterization and in coal utilization is the intractability of the coal macromolecular network. High temperature treatments yield smaller, volatile and soluble molecules, which can be greatly altered from their original structures, along with a significant amount of a non-volatile char. Mild oxidation should provide a soluble mixture of compounds in higher yields and with structural characteristics more like the original coal. The approach described in this paper attempts to oxidatively cleave only activated benzylic sites in the coal macromolecules in a two step process.

42958 **An electron spin resonance investigation of free radicals in lignite formed using programmed temperatures, H/sub 2/S, CO and H/sub 2/.** Nowok, J.; Steinberg, V.I. (Dept. of Chemistry, Univ. of North Dakota, Grand Forks, ND 58202). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **31**: No. 4, 130-139(Sep 1986). (CONF-860911—).

From 192. American Chemical Society national meeting; Anaheim, CA, USA (7 Sep 1986).

To increase the liquid yields of coal liquefaction, ESR spectra of unconverted coal residues are related to reactor conditions and conversion into volatile products. ESR spectra were obtained for North Dakota Zap lignite treated with various reducing gas atmospheres using a linear-programmed reactor temperature range of 300-500°C. The line shape, spin density, linewidth and g-values were all found to vary with the nature of the reducing gases employed.

42959 **Structural features of products derived from water-assisted liquefaction of bituminous coals.** Ruether, J.A.; Lett, R.G.; Mima, J.A. (Pittsburgh Energy Technology Center, P.O. Box 10940, Pittsburgh, PA 15236). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **31**: No. 4, 140-151(Sep 1986). (CONF-860911—).

From 192. American Chemical Society national meeting; Anaheim, CA, USA (7 Sep 1986).

The inference has been made that similar weak bonds in the coal macromolecular structure are being broken in both aqueous and conventional coal liquefaction systems and that the products reflect some statistical regularity or uniformity in the distribution of chemical entities that constitute the coal macromolecular structure. Thus, although increasing the reduction (chemical) severity may increase the rate of bond breaking by chemical rather than thermal mechanisms, the observed result is primarily a larger number of liberated fragments rather than a change in their character. The present work indicates a similar interpretation is consistent with the reaction systems studied here. This work examines the structural features of coal liquids produced under a variety of unconventional reaction conditions.

0108 Waste Management

REFER ALSO TO CITATION(S) 42940, 42947, 42967. 43209, 43225, 43226, 43227, 43229, 43230, 43480, 43636, 43970, 43976

42960 **(DOE/MC/21108—2238) Management of coal waste by energy recovery: Mild gasification/flash pyrolysis of coal preparation waste: Quarterly report (draft) for the period July-September 1986.** Chu, C.I.C.; Gillespie, B.L. (SEE CODE- 9501512 UCC Research Corp., Bristol, VA (USA)). Nov 1986. Contract AC21-84MC21108. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87003823.

One of the most perplexing problems facing the coal industry is how to properly dispose of the waste and/or even recovery a small fraction of the Btu value of the waste, while minimizing the environmental concerns. UCC Research considers this monumental environmental problems as an opportunity to recovery useable organic materials and reduce the environmental problems created by coal waste. Mild gasification is the method used by UCC Research to realize these objectives. Coal feedstocks are fed into the mild gasification system yielding liquids, char, and gases for commercial application. The program consists of seven tasks: Task 1, Characterize Management of Coal Preparation Wastes; Task 2, Review Design Specifications and Prepare Preliminary Test Plan; Task 3, Select and Characterize Test Feedstocks; Task 4, Acquire/Construct Process Elements; Task 5, Prepare Final Test Plan; Task 6, Implement Final Test Plan; Task 7, Analyze Test Results and Assess System Economics. A schedule of the program is given. The program was initiated on September 30, 1984. Tasks 1, 2, 3, 4, 5, and 6 have been completed. Work is continuing on Task 7.

42961 **(PB—87-190609/XAB) Prevention of the formation of acid drainage from high-sulfur coal, coal refuse, and coal spoils by inhibition of iron and sulfur oxidizing microorganisms. Final report, 1 October 1977-30 June 1981.** Dugan, P.R. (Ohio State Univ. Research Foundation, Columbus (USA)). Jun 1985. 82p. NTIS, PC A05/MF A01.

Acid drainage is a problem associated geographically and geologically with the mining industry and is due to production or sulfuric acid from sulfur-containing minerals. The data presented in the report demonstrate that it is possible to inhibit pyrite-oxidizing bacteria in high sulfur coal refuse with a concurrent reduction in acid drainage formed in the refuse. The most effective inhibitors studied are combinations of sodium lauryl sulfate (SLS) plus sodium benzoate (Bz), both of which are relatively nontoxic to higher organisms.

42962 **(PB—87-194783/XAB) Status and evaluation of calcitic SO_2 capture: analysis of facilities performance.** Silcox, G.D.; Chen, S.L.; Clark, W.D.; Kramlich, J.C.; La Fond, J.F. (Energy and Environmental Research Corp., Irvine, CA (USA)). May 1987. 341p. NTIS, PC A15/MF A01.

The report gives results of a characterization of the current state of knowledge regarding SO_2 capture by dry calcitic sorbent injection. In this project, the experimental data on dry sorbent injection are compiled and critically compared. Sulfation and activation models are developed and used to identify sorbent properties and furnace-environment parameters likely to be of importance. The results of the examination of data and the model evaluation indicated areas where original experimental work could be applied to resolve key issues. The experimental portion of the program developed information on injection temperature, quench rate, and sorbent properties. These results are used to define the overall optimum injection condition for a variety of furnace configurations.

42963 **(PB—87-199634/XAB) Evaluation of boiler-design modifications for enhanced LIMB application. Final report, September 1985-July 1986.** Ryan, D.E.; Smolenski, R. (Babcock and Wilcox Co., Barberton, OH (USA)). Jun 1987. 94p. NTIS, PC A05/MF A01.

This report gives results of a study to evaluate the technical and economic impact of designing wall-fired pulverized-coal units to incorporate dry-sorbent sulfur control technology (LIMB). Conventional (non-LIMB) units were set up in three sizes (200, 400, and 600 MW) to burn a low-sulfur (0.48%) subbituminous fuel. LIMB units were then set up to achieve 70% SOx removal using dry-sorbent injection. Standard cost-estimating procedures were used to evaluate the cost differentials between the conventional and LIMB units. These cost data were used to establish removal cost trends as a function of calcium-to-sulfur (Ca/S) mole ratios and boiler size. The study concluded that it is technically feasible to achieve 70% sulfur removal in a unit burning low-sulfur fuel using only dry-sorbent injection. The results also showed that Ca/S ratios between 2.8 and 3.5 can be accommodated without radical alterations to state-of-the-art boiler configurations.

42964 **(PB—87-202859/XAB) Production of concrete containing fly ash for pavement applications. Interim report.** Olek, J.; Tikalsky, P.J.; Carrasquillo, R.L. (Texas Univ., Austin (USA). Center for Transportation Research). May 1986. 180p. (CTR—3-9-84-364-2). NTIS, PC A09/MF A01.

The study addresses some of the major concerns of resident highway engineers about concrete containing fly ash for highway applications, which include: curing conditions, setting times, strength development, and durability. The report summarizes the experimental observations and conclusions from a research program investigating the properties of both fresh and hardened pavement concrete containing fly ash. Tests were performed to establish guidelines for the selection of materials and trial-mix design procedures for producing quality concrete containing fly ash.

0109 Environmental Aspects

REFER ALSO TO CITATION(S) 42976, 43208

42965 (CONF-8610316—, pp 14.1-14.33) **Land reclamation in the coal mining areas of Czechoslovakia.** Stys, S. 1986. (In German). NTIS (US Sales Only), PC A99. File Number DE87752961.

From CSR symposium and exhibition concerning the planning and protection of the human environment; Duesseldorf, F.R. Germany (1 Oct 1986).

The land reclamation technology for the coal mining areas in Czechoslovakia was staged as follows: 1) Mining-engineering reclamation using suitable transportation systems and involving selective removal of fertile soil, and 2) ecological engineering involving landscaping and soil melioration as well as farming and agricultural engineering.

42966 (CONF-8610316—, pp 30.1-30.7) **Land reclamation in the brown-coal open-pit mines of the brown-coal region of the Rhineland.** Goedecke, H. 1986. (In German). NTIS (US Sales Only), PC A99. File Number DE87752961.

From CSR symposium and exhibition concerning the planning and protection of the human environment; Duesseldorf, F.R. Germany (1 Oct 1986).

137 sqkm out of the 223 sqkm area used by brown-coal mining in the Rhineland region since its beginning, have been reclaimed already. 45% of these have been reclaimed for agricultural and silvicultural applications. The rest is dedicated to water bodies, roads and industrial sites. To-date 47 lakes with a total surface area of 690 ha have been built and a further 5 with some 200 ha surface area are planned to be built throughout the next 10 years.

42967 **(ECN—87-089) Leaching characteristics of hazardous elements from coal fly ash as a function of the acidity of the contact solution and the liquid/solid ratio.** De Groot, G.J.; Wijkstra, J.; Hoede, D.; Van der Sloot, H.A. (Netherlands Energy Research Foundation, Petten). May 1987. 23p. (CONF-870511—2). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

From 4. international hazardous waste symposium on environmental aspects of stabilization-solidification of hazardous and radioactive wastes; Atlanta, GA, USA (3 May 1987).

To estimate the environmental consequences of the storage and utilization of coal fly ash, in the Netherlands a standard leaching test has been developed. In this test leachability conditions are used in which close approximation with field conditions are aimed at. The standard test consists of three main parts: a column leaching test, a serial batch leaching test and a test for the determination of maximum leachability. As a time scale the liquid/solid ratio (L/S) is used, where L/S is the ratio between the total quantity (L) of liquid used for leaching and the weight (KG) of the leached material. The relation between this relative time scale and the actual time scale depends on the time required for a L/S ratio to be reached in the actual situation. Ashes from a wide variety of sources were analyzed. Five different ashes were submitted to the complete standard leaching test described. They show common leaching characteristics for several groups of elements. Limited solubility of anions at high pH (> 11) has been observed. Experiments with artificial fly ash are in good agreement with the concentrations found in normal fly ash extracts. The experimental data of all batch experiments are summarized in three-dimensional graphs relating element concentration in solution, pH and L/S ratio. It shows that the pH is the main factor in controlling the leachability. 9 refs.

42968 **(ECN—87-093) Leaching characteristics of construction materials and stabilization products containing waste materials.** Van der Sloot, H.A.; De Groot, G.J.; Wijkstra, J. (Netherlands Energy Research Foundation, Petten). Jun 1987. 55p. (CONF-870511—3). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

From 4. international hazardous waste symposium on environmental aspects of stabilization-solidification of hazardous and radioactive wastes; Atlanta, GA, USA (3 May 1987).

Construction materials prepared with an admixture of waste material(s) and various stabilized waste products have been subjected to leaching studies. Static and dynamic leach tests are applied, in which the specimen to be studied is fully submerged in demineralized water or in seawater. At increasing time intervals the contact solution is renewed and the flux of elements into solution is measured. By studying a wide range of products containing waste materials attempts have been made to find common leaching characteristics. Materials studied to date comprise mortar specimen with a 20% cement replacement by pulverized coal ash, phosphate slag, light weight concrete with 50% of pulverized coal ash, stabilized phosphogypsum and stabilized products prepared from combinations of pulverized coal ash, phosphogypsum, incinerator ash, blast furnace slag, lime or cement. The alkalinity of the material, the open porosity of the product and the surface to volume ratio prove to be important factors in controlling the release of potential hazardous elements from materials containing waste products. In these studies leach parameters on (trace) elements are related to those of sodium. Since the interaction of sodium with the solid phase is usually small, sodium can be used as an indicator for the tortuosity of the product. Elements leached from cement-based waste products are mainly anionic species, like Mo, B, V, F and SO/sub 4/-ions, whereas leaching of metals, like Cu, Cd, Zn and Pb, is limited due to the high pH in the pore solution. The leaching experiments have been verified by scanning electron microscopy for major components on field samples and by measuring depth profiles in waste products for trace constituents using apparatus developed for this purpose.

42969 **(KEMA—5342-85-MOL) The emission of air pollutants by coal fired power stations.** Janssen, L.H.; Van der Kooij, J.; Meij, R. (Keuring van Electrotechnische Materialen N.V., Arnhem (Netherlands)). Nov 1985. 37p. (In Dutch). N.V. KEMA, P.O. Box 9035, 6800 ET Arnhem, Netherlands.

Measurements of the emission of the coal fired Amer power station (Geertruidenberg, Netherlands) showed that (a) emission of sulfur- and nitrogen-oxides were relatively small, due to the use of low-sulfur coal and the use of advanced combustion equipment, (b) the emission of fly ash and dust is strongly limited by the use of high-performance electrostatic precipitators and (c) the emission of harmful polycyclic aromatic hydrocarbons is negligible. A rough

estimation is given of the future emission of the Amer power station, starting from an expected increase of power consumption of 1% a year.

42970 (SRO—819-17, pp 34-37) **Polycyclic aromatic hydrocarbons in SRP aquatic sediments.** Mills, G.L.; Norton, D. Sep 1986. NTIS, PC A09/MF A01. File Number DE87012054.

In Ecological research at the Savannah River Ecology Laboratory: Annual report for the period ending July 31, 1986.

Although numerous studies have addressed the problem of inorganic contaminants associated with runoff from coal piles, little information is available on contamination by organic compounds, including PAH, that are known to be present in coal. During the past year the authors began a study to determine the input of PAH from coal pile runoff in the 400 D-Area to the aquatic systems on the SRP and the Savannah River. The authors are also trying to estimate the input of PAH from other sources in order to place the relative contribution from coal pile runoff in a general perspective. These studies are part of a larger effort to investigate the release and biogeochemical cycling of contaminants from coal piles and ash basins in the 400 D-Area, particularly as they relate to potential surface and groundwater contamination. 2 figures, 1 table.

0120 Mining

REFER ALSO TO CITATION(S) 42980

42971 **(PB—87-194338/XAB) Pillar load transfer associated with multiple-seam mining. Report of Investigations/ 1987.** Matetic, R.J.; Chekan, G.J.; Galek, J.A. (Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center). 1987. 30p. (BM-RI—9066). NTIS, PC A03/MF A01.

Library of Congress catalog card No. 86-600360.

As part of a program to improve mine planning and development, the Bureau of Mines is investigating the effects of pillar load transfer which impacts on mining operations within a multiple-seam configuration. At two mine sites, the Bureau performed a complete geological analysis and installed and monitored instrumentation to gather pertinent data on rock mechanics. Overburden depth varied dramatically in the vicinity of the study area and reached a maximum at the study site; innerburden thickness was less than a pillar width (40 to 45 ft); heaving was experienced in both mines where sandstone and/or shale floor units were observed; overlays of the mine layouts show pillars were not totally superpositioned; a maximum of 5 in of roof to floor convergence was measured; and pressure readings indicated pillar core loading only and increased to a maximum of 7,000 psig over instrument setting pressure.

0130 Transport And Handling

42972 **(EPRI-CS/P—5292) Coal slurry transportation alternatives: Conceptual design and economics: Final report.** Mann, C.E.; Manning, S.H. (Dames and Moore, Bethesda, MD (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jul 1987. 160p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920549.

The Coal Slurry Transportation Alternatives study provides utilities with a decisionmaking tool and necessary cost data to facilitate a systematic and rigorous comparison of slurry, rail, and barge transportation from the mine to the busbar for coal deliveries to both existing and new power plants. Volume 3 summarizes the methodology and results of examining operating and cost differences between slurry and run-of-mine coal. Two objectives of the study are to document the engineering costs and assumptions of the coal slurry pipeline system and to provide comparative estimates of costs and performance for power generation from slurry pipeline and run-of-mine coal. The results indicate that an increase in fuel moisture causes a decrease in boiler efficiency; that is, higher fuel burn rates and higher gas flows. For new plants, major equipment must be sized to accommodate higher fuel, ash, and flue gas flow rates associated with coal slurry. Other impacts include higher auxiliary power requirements, increased scrubber additive requirements, and potential increases in plant maintenance. For existing plants, a more serious concern may be the capability of current fuel transport systems to properly dry and transport the fuel. Flue gas flow rates for slurry should be within the design margins of run-of-mine, but where flue gas flow rates are increased, downstream FGD and particulate removal equipment may be impacted. Of the total levelized busbar costs for new plants, approximately 40 percent of differential costs are associated with capital, with the remaining 60 percent associated with consumables. For existing plants, replacement power costs due to limitations in fuel drying and conveyance may be up to 20 percent of the total generation cost. 40 figs., 62 tabs.

42973 **(TNO-PML—1985-C-56) Heat production of stockpiled coal, stored under standardized conditions at the Amer power station.** Van Liempt, J.H. (Prins Maurits Lab. TNO, Rijswijk (Netherlands)). 1985. 23p. (In Dutch). Prins Maurits Laboratorium TNO, P.O. Box 45, 2280 AA Rijswijk, Netherlands.

Some properties of a type of coal which is to be used in a large-scale storage project under pre-defined conditions have been determined. These properties comprise the contents of volatiles, the apparent density, the caloric value, the specific heat and the ignition temperature of the coal sample. Further, the degradation of the coal, including the influence of the temperature and of the oxygen concentration of the gas phase, has been investigated. This investigation has been performed using the isothermal and the adiabatic storage test.

0140 Combustion

REFER ALSO TO CITATION(S) 42950, 42951, 42969

42974 **(ECN—87-037) Plume wash-out near a coal-fired power plant: measurements and model calculations.** Ten Brink, H.M.; Janssen, A.J.; Slanina, J. (Netherlands Energy Research Foundation, Petten). Mar 1987. 42p. ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

The contribution of plume wash-out to the wet deposition of pollutants in the vicinity of a 1000 MW coal-fired power plant in The Netherlands has been investigated. Whereas the extra deposition of heavy metals, emitted in the form of fly-ash, is not of importance as compared to the background deposition, drastically increased wet deposition of chloride, fluoride and especially boron compounds was observed. Little extra deposition of sulfur compounds was found, due to the fact that increased acidity in precipitation, associated with wash-out of hydrogen chloride and, to a lesser extent, hydrogen fluoride, limits the uptake of sulfur dioxide. The results of the experiments near the 1000 MW installation were used to test and validate a washout model developed to study and predict wet removal of the major pollutants from a plume. Annual wet deposition patterns of these constituents due to plume washout have been calculated for a more characteristic 600 MW coal-fired power plant. At short distances plume wash-out may double local acid deposition under conditions prevalent in The Netherlands. This is mainly the result of wash-out of HCl, whereas the contribution of SO/sub 2/ is negligible. Significant plume contributions to the depositions of HF and boron compounds may also be expected. Application of desulfurization units ('scrubbers') will reduce the emission and deposition of acids. 10 figs., 6 tabs., 22 refs.

42975 **(ECN—87-076) Volatile inorganic trace emissions from coal-fired boilers.** Ten Brink, H.M.; Alderliesten, P.T.; Van der Sloot, H.A.; Meij, R. (Netherlands Energy Research Foundation, Petten). May 1987. 7p. ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

Emissions of B, Br, Cl, F, Hg and Se from pulverized coal-fired power plants in The Netherlands have been investigated in order to be able to estimate possible environmental consequences. Gas samples were taken from the flue gas down-stream of the electrostatic precipitators using activated charcoal cartridges and impingers (for F and Cl) at 120 C. Apart from direct gas measurements volatile emissions can be deduced from balance studies. The imbalance between ingoing coal and outgoing ash streams could then be assigned to vapor phase emissions. Another approach is to compare the concentration of an element in the coal ash with the

concentration in the bottom ash, collected ash and fly ash, assuming coal ash is divided over these ash streams in a ratio of 10%, 90% and 0.1% respectively. Analyses were carried out by means of neutron activation analysis and standard chemical procedures. Results are presented. 3 tabs., 3 refs.

42976 **(KEMA—85-40-MOL) Study on the oxidation of nitrogen monoxide in plumes of coal-fired power plants.** Janssen, L.H.; Vaessen, R.J. (Keuring van Electrotechnische Materialen N.V., Arnhem (Netherlands)). May 1985. 26p. (In Dutch). N.V. KEMA, P.O. Box 9035, 6800 ET Arnhem, Netherlands.

In the framework of the Dutch National Program Plan on Coal, subprogram: Air pollution by emissions of coal-fired power plants, the oxidation of NO in plumes has been studied. Actual measurements of SO/sub 2/, NO, NO/sub x/ and O/sub 3/ have been compared with stack measurements of the same components and results were analyzed with a simple model which describes the mixing of ambient air in a plume. Sampling has been done by airplane at 1, 5, and 10 km distance from the plant and on groundlevel by car at 10 km distance from the power plant. Data and results are presented. 12 figs., 3 tabs., 12 refs.

42977 **(LA—11045-MS) KIVA COAL: A modified version of the KIVA program for calculating the combustion dynamics of a coal-water slurry in a diesel engine cylinder.** Gentry, R.A.; Daly, B.J.; Amsden, A.A. (Los Alamos National Lab., NM (USA)). Aug 1987. Contract W-7405-ENG-36. 73p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87012676.

This report describes the KIVA COAL computer program, designed to calculate the time evolution of the combustion of a coal-water slurry in the cylinder of a diesel engine, using a Cray computer. This program, which has been obtained by modifying the Los Alamos KIVA program, developed by Amsden et al. for studying the combustion of conventional liquid-fueled diesel engines, calculates the detailed in-cylinder gas dynamics, spray motion, slurry evaporation, and devolatilization of the coal particles, char combustion, chemical reactions with heat-release, and the radiative heat transfer processes that occur in engine operation. The KIVA code can calculate 2-D axisymmetric problems and 3-D problems that can be characterized by periodic boundary conditions in the azimuthal direction. The program uses chemistry, char combustion, devolatilization, and radiation heat transfer models developed by Daly in a previous study of coal gasification. 28 refs., 13 figs., 1 tab.

42978 **(PB—87-197661/XAB) Report on an investigation into the combustion of various coals in a chain-grate stoker-fired boiler.** North, B. (National Inst. for Coal Research, Pretoria (South Africa)). 1987. 34p. (COAL—8514). NTIS, PC PC E05/MF E05.

North American Continent sales only.

This report deals with the combustion of smalls and the combustion of peas. The coals tested were New Clydesdale (NC) smalls, Arthur Taylor Colliery (ATC) peas and Transvaal Navigation Colliery (TNC) peas. Where more than one consignment of a certain coal was used this has been indicated, e.g., TNC peas I and TNC peas II. Tests were carried out at three different loads, nominally 100%, 80%, and 50% of the Maximum Continuous Rating (MCR). Where possible, multiple tests were carried out at the same load in order to provide a representative average figure for the thermal efficiency.

42979 **(TNO-HMT—86-213) Mathematical modelling of fluid-bed combustion of coal.** Brem, G. (Hoofdgroep Maatschappelijke Technologie TNO, Apeldoorn (Netherlands)). Aug 1986. 107p. (In Dutch). Hoofdgroep Maatschappelijke Technologie TNO, P.O. Box 342, 7300 AH Apeldoorn, Netherlands.

Only a limited number is known of mathematical models that describe the processes in a fluid-bed coal combustor. Among these the CANMET-model, developed in 1985 by F. Preto at the Queens' University, Ottawa, Canada, is the completest and most easy to handle. After some modifications this model is fit to describe quite satisfactorily the combustion in the TNO-Atmospheric Fluid-Bed Boiler (TNO-AFBB). The model contains parameters, characteristic for the processes in the AFBB during operation (combustion, heat transfer, afterburning, nitrogen oxidation, sulfur capture, reduction reactions, etc.). Some of these parameters do influence the computation results significantly (diffusion and mixing of gases, sulfur capture, reduction of nitrogen oxides). Much attention must be paid to the determination of these model parameters. Validation of the CANMET model in the experiments with the TNO-AFBB shows that the model predicts the measured values well enough. These results may even be improved when more data about the processes in the bed and afterburning chamber are available, as gas concentration profiles and dimensions of the boiler.

0150 Marketing And Economics

REFER ALSO TO CITATION(S) 42939, 42945, 43430, 43478

0160 Health And Safety

REFER ALSO TO CITATION(S) 43982

42980 **(PB—87-194320/XAB) Coal-mine-hazard detection using in-seam ground-penetrating-radar transillumination. Report of Investigations/1987.** Foss, M.M.; Leckenby, R.J. (Bureau of Mines, Denver, CO (USA). Denver Research Center). 1987. 34p. (BM-RI—9062). NTIS, PC A03/MF A01.

Library of Congress catalog card No. 86-600286.

The Bureau of Mines recently completed peliminary studies to demonstrate the feasibility of using Ground-Penetrating Radar (GPR) for in-seam hazard detection. Investigations included air and coal tests for the purpose of checking equipment accuracy, coal penetration, and other factors such as the effects of receiver orientation. Further investigations involved using both a short pulse and a new prototype synthetic-pulse system to locate a clay vein in a coal seam using transillumination. Data were gathered on multiple travel paths, and a back-projection processing technique was then used to create a tomographic image using the calculated velocities. A computer model of the same coal seam was subsequently processed using the same tomogrpahic technique, and the results were compared with those of the actual data. Results of these preliminary studies show that GPR is feasible for use in in-seam hazard detection and point the direction that future research should take.

02 PETROLEUM

0201 Reserves

REFER ALSO TO CITATION(S) 43421

0202 Geology And Exploration

REFER ALSO TO CITATION(S) 44103, 44106, 44112, 44115, 44125, 44217, 44633

42981 **(DOE/NBM—7014065) Geosciences research for oil and gas discovery and recovery.** (USDOE, Washington, DC). Mar 1987. 30p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87014065.

Public Laws 99-500 and 99-591 stipulated that the Department of Energy (DOE) must provide a report to the Congress on geoscience research related to oil and gas discovery and recovery. This report describes the research necessary to meet challenging goals for increasing domestic oil and gas. There are no economics discussed in conjunction with the research. Each program within the Department provides the economic rationale for its priorities within its own program plans and budget. This report of research needs recognizes the technical complexity of discovering and then converting the Nation's oil and gas resources to reserves. The overview was created to provide direction and focus for a National effort that, if economically feasible, will benefit greatly from a

broad range of geoscience research. DOE will work to coordinate these activities.

42982 **(PB—87-189221/XAB) Alaska OCS (Outer Continental Shelf) socio-economic studies program. Technical report number 88. Diapir field statewide and regional economic and demographic systems impact analysis. Final technical report.** Knapp, G.; Reeder, B.; Goldsmith, S. (Alaska Univ., Anchorage (USA). Inst. of Social and Economic Research). Jun 1983. 170p. NTIS, PC A08/MF A01.

See also PB—85-155117; Portions of this document are not fully legible.

The study projects economic and demographic impacts of OCS Lease Sale 87, scheduled for June of 1984 in the Beaufort Sea. Base-case and impact projections are developed for the state of Alaska and for Anchorage and Fairbanks using the MAP econometric model. The maximum projected impact of a 3.0 BBBL oil development in Sale 87 leases is an increase of about 3% in total state population and employment. Similar impacts occur for Anchorage and Fairbanks. In both absolute and percentage terms, projected impacts are greater after the year 2000 than in the 1990s, when peak direct employment associated with the sale would occur. This is because most future growth in Alaska is associated with support-sector expansion; the effect of Sale 87 is to cause growth to occur earlier.

42983 **(PB—87-194387/XAB) Analysis of trace metals in bottom sediments in support of deepwater biological processes studies on the US mid-Atlantic continental slope and rise. Final report, March 1, 1984-March 31, 1987.** Bothner, M.H.; Campbell, E.Y.; DiLisio, G.P.; Parmenter, C.M.; Rendigs, R.R. (Geological Survey, Woods Hole, MA (USA)). 31 Mar 1987. 87p. NTIS, PC A05/MF A01.

See also PB—86-199312.

The concentration of 12 metals (Al, Ba, Cd, Cr, Cu, Fe, Hg, Mn, Ni, Pb, V, and Zn) were measured in sediments over a two-year period in order to evaluate the impact of drilling-mud discharges on the continental slope off the Middle Atlantic states. Barium, a major element in drilling mud, was the only element found to increase in concentration as a result of drilling and only at stations adjacent to drilling rigs. The small changes (32% or less) were measured only in some of the replicate samples, indicating a patchy distribution of the Ba introduced by drilling. There was no evidence of accumulating drill cuttings in the sediment cores that the authors analyzed. Discrete particles of barite were observed in trap samples and in bottom sediments by means of a scanning electron microscope. The overall goal is to evaluate potential adverse effects of drilling effluents on bottom-dwelling organisms.

42984 **(PB—87-199428/XAB) Alaska OCS (Outer Continental Shelf) social and economic studies program. Technical report Number 91. Effects of renewable resource harvest disruptions on socio-economic and socio-cultural systems: Wainwright, Alaska. Final technical report.** Luton, H.H. (Muir (John) Inst. for Environmental Studies, Inc., Napa, CA (USA)). Jan 1985. 604p. NTIS, PC A99/MF A01.

See also PB—87-199436.

Contents include: ethnographic baseline, Wainright, Alaska; social institutions; the cash economy; kinship; subsistence task groups; subsistence economy; sharing; land mammals; marine mammals - Part 1 and 2; birds; fish, invertebrates, plants, minerals; ethnographic summary & conclusions.

42985 **(PB—87-199469/XAB) Alaska OCS (Outer Continental Shelf) social and economic studies program. Technical report Number 99. A description of the socioeconomics of Norton Sound. Final technical report.** McNabb, S.; Robbins, L.; Waring, K.; Wasserman, P.; Weber, K. (Muir (John) Inst. for Environmental Studies, Inc., Napa, CA (USA)). Mar 1984. 476p. NTIS, PC A21/MF A01.

See also PB—87-199451.

The study focuses on three main variables, (economic activity, employment opportunity, and inflation) which may be expected to change significantly in the Norton Sound region of Alaska as a result of OCS activities. Five primary categories (demography, economics, social organization, values and attitudes, and infrastructure) were studied. Field data were collected from 82 families in the villages of Savoonga, Nome, Golovin, Unalakleet, and Emmoank. Some primary data from Alakanuk and Gambell were also used in portion of the analysis. The region lacks the geographical, infrastructural, commercial, and other economic assets to attract offshore industries and workers.

42986 **(PB—87-200036/XAB) Alaska OCS social and economic studies program. Technical report Number 94. Diapir field Anchorage impacts analysis. Final technical report.** (Waring (Kevin) Associates, Anchorage, AK (USA)). Mar 1984. 209p. NTIS, PC A10/MF A01.

The purpose of the study is threefold: (1) to update earlier baseline descriptions of Anchorage region; (2) to revise the community impact-assessment methodology to be applied to the Anchorage region; and (3) to assess the community impacts on the Anchorage region through the year 2010 of a base-case growth forecast and of a scenario for production of 3.0 billion barrels of crude oil from the Diapir Field OCS Sale no.87. Some results of the study are that the Anchorage region, historically and currently, has demonstrated a very resilient capacity to accommodate rapid economic and population growth; and that State expenditure of petroleum revenues accounts for much of the region's recent growth.

0203 Drilling And Production

REFER ALSO TO CITATION(S) 42981

42987 **(PB—87-186391/XAB) Offshore oil development in California: challenges to governments and to the public interest.** Cicin-Sain, B. (California Univ., Berkeley (USA). Inst. of Governmental Studies). 1986. 18p. NTIS, PC A02/MF A01.

Pub. in Public Affairs Report, Vol. 27, No. 1-2(Feb-Apr 1986).

The purpose of this paper is to characterize the major challenges to governments and to the public that are posed by the accelerated pace in oil development now taking place offshore California. In recent years, huge oil discoveries have been made off the South/Central Coast of California in the Santa Barbara Channel and in the Santa Maria Basin. A number of oil-development proposals are now being considered by relevant federal, state, and local authorities. The article first characterizes the magnitude of the current oil build-up, placing it in historical perspective. Next, it describes the major issues posed by accelerated development, and the complex of federal, state, and local laws that govern offshore oil extraction.

0204 Processing

REFER ALSO TO CITATION(S) 42933, 42935, 42936, 42937, 42938

42988 **(AD-A—180772/6/XAB) Pilot-scale distillation and characterization of diesel-fuel fractions of Strategic Petroleum Reserve crude oils. Interim report, December 1985-February 1987.** Morris, D.L.; Bailey, B.K.; Stavinoha, L.L.; Giles, H.N. (Southwest Research Inst., San Antonio, TX (USA). Belvoir Fuels and Lubricants Research Facility). Feb 1987. 62p. (BFLRF—224). NTISMF A01.

Availability: Microfiche copies only.

Little, beyond crude assay data, has been known about the properties of various fuel fractions, including diesel fuel, that might ensue in the event crude oils available at the Strategic Petroleum Reserve were actually to be refined. Accordingly, eight distinct crude-oil streams were collected from the Reserve and subjected to distillation in a pilot-scale unit. Middle distillate fractions were prepared in an attempt to approximate production of diesel fuel, and the fractions were characterized by ASTM tests and evaluated according to the requirements of VV-F-800 and other criteria. VV-F-800 is the Federal Diesel Fuel Specification. Results of the distillation effort were documented and indicate a successful effort over the range of operating conditions explored. The diesel fuels produced exhibit cetane numbers greater than specification requirements and can be expected to be stable. The data indicate that fuels conforming to VV-F-800 can be obtained from Strategic Petroleum

Reserve crude oil, although a normal amount of additional upgrading may be required. Recommendations are made to examine such upgraded material, including full-scale engine testing, to demonstrate the power and performance of both treated and untreated fuels.

42989 **(AD-A—181070/4/XAB) Production of jet-fuel samples from light-cycle oil and light-pyrolysis oil. Final report, November 1985-March 1986.** Hall, L.W. (Sun Refining and Marketing Co., Marcus Hook, PA (USA)). 31 Mar 1987. 25p. NTIS, PC A02/MF A01.

Work under this program was directed toward production of test fuel samples from light cycle oil (LCO) and light-pyrolysis fuel oil (LPFO) feedstocks. The processing sequence used to produce three samples involved hydrodesulfurization of LCO followed by high-pressure batch hydrogenation over sulfided nickel/molybdenum catalyst to achieve a desired aromatic content of 20, 30, and 45%. LPFO was hydrostabilized over nickel on silica/alumina catalyst followed by high-pressure batch hydrogenation over nickel/molybdenum catalyst to achieve an aromatic content of 30%. Four test samples in excess of 2000 gallons were produced and delivered in bulk and in drums as specified.

42990 **(FRNC-TH—2133) Contribution to the study of water-hydrocarbon separation by flotation.** Siem, N. (Toulouse-3 Univ., 31 (France)). 1983. 140p. (In French). NTIS (US Sales Only), PC A07/MF A01. File Number DE87753162.

Flotation mechanisms are studied for its application to the separation of water-hydrocarbon emulsion. At a pilot scale two flotation techniques are studied: flotation with dissolved air (bubble mean diameter 70 microns) and flotation with dispersed air (bubble mean diameter 2 mm). Influence of superficial charge of hydrocarbon droplets is evidenced either by pH variation or by addition of a coagulant. Interaction mechanism of air bubbles and hydrocarbon droplets are observed by cinematographic techniques. Configurations are explained by interfacial energy. A flotation column is modelized. 25 refs.

0205 Products And By-products

42991 **(EUR—10571-EN) EXVEMA - explosion venting manual.** Labath, N.; Mazzocchi, S. (Commission of the European Communities, Luxembourg. Directorate General Information Market and Innovation). 1987. 112p. Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities.

Physical sciences.

This is a manual intended to help the design engineer in the selection of the most appropriate methods to protect vessel, duct or building from overpressures caused by deflagrations. Theoretical methods are outlined and many practical methods are given to define the design parameters and the number of venting devices. Some recommended practices for a good detailed design of venting devices are given, as well as some recommended practices to prevent deflagrations. A bibliographical review is included, with some comments for every reference, which are intended as a guide to find the reference(s) that may help the design engineer to get better understanding and information about his particular case or problem.

0206 Health And Safety

REFER ALSO TO CITATION(S) 43001, 43988

0207 Marketing And Economics

REFER ALSO TO CITATION(S) 43401, 43420, 43430

42992 **(PB—87-199444/XAB) Alaska OCS (Outer Continental Shelf) social and economic studies program. Technical report Number 96. Ethnographic study and monitoring methodology of contemporary economic growth, socio-cultural change and community development in Nuiqsut, Alaska. Final technical report.** Galginaitis, M.; Chang, C.; MacQueen, K.M.; Dekin, A.A.; Zipkin, D. (State Univ. of New York, Binghamton (USA). Research Foundation). Jun 1985. 456p. NTIS, PC A20/MF A01.

See also PB—87-199451.

The report is a case study of the community of Nuiqust, Alaska. It is a traditional Village on the North Slope of Alaska. It was resettled in April 1973. The Alaska Native Claims Settlement Act and the formation of the North Slope Borough (NSB) created a fiscal, social, and political environment to make it a viable undertaking. Many of the founding families were closely related. Approximately 2/3 of the 170 settlers remain among the present 270 village residents. Oil development, as such, has little direct effect on Nuiqust. Few Inupiats work for Oil Companies. However, the money that supports the community is derived from oil through taxes imposed by the NSB on facilities at Prudhoe Bay. Subsistence is a primary activity in the community, and oil activities (both onshore and offshore) are perceived by the Inupiats as having adverse impacts, both in terms of numbers and access.

0209 Environmental Aspects

REFER ALSO TO CITATION(S) 42983, 44104, 44107, 44108, 44110, 44215

42993 **(PB—87-194213/XAB) Calibration and evaluation of a dispersant application system.** Shum, J.S. (Mason and Hanger-Silas Mason Co., Inc., Leonardo, NJ (USA)). May 1987. 88p. NTIS, PC A05/MF A01.

The report presents recommended methods for calibrating and operating boat-mounted dispersant application systems. Calibration of one commercially-available system and several unusual problems encountered in calibration are described. Charts and procedures for selecting pump rates and other operating parameters in order to achieve a desired dosage are provided. The calibration was performed at the EPA's Oil and Hazardous Materials Simulated Environmental Test Tank (OHMSETT) facility in Leonardo, New Jersey.

42994 **(PB—87-194635/XAB) Offshore environmental studies program: regional studies plan, Fiscal Year 1987.** (Minerals Management Service, Vienna, VA (USA). Atlantic OCS Region). 1986. 67p. (OCS/MMS—86/0040). NTIS, PC A04/MF A01.

See also PB—87-195954.

The purpose of the document is to present the Final FY 1987 Atlantic Outer Continental Shelf (OCS) Regional Studies Plan. The plan is organized by sections beginning with the criteria for ranking studies that is based on directions from the Branch of Environmental Studies. For FY 1987, 16 proposed studies for the Atlantic OCS Region have been ranked in priority order within study classes. The FY 1987 proposed studies are listed by: study title, status, description and objectives, and application of ranking criteria. The three non-energy mineral studies are included but are not ranked.

42995 **(PB—87-195145/XAB) Baffin Island experimental oil spill and dispersant studies. Hydrocarbon bioaccumulation and histopathological and biochemical responses in marine bivalve molluscs. Final report.** Neff, J.M.; Hillman, R.E.; Boehm, P.D. (National Ocean Service, Anchorage, AK (USA). Ocean Assessments Div.). Feb 1984. 145p. NTIS, PC A99/MF E04.

Infaunal bivalve molluscs from four bays at the BIOS experimental oil-spill site became contaiminated with petroleum hydrocarbons. A Lagomedio crude oil and the dispersant, Corexit 9527, were used in these field experiments. Based on chemical data, both Mya and Serripes depurated oil during the two-week post-spill period, in part through an in vivo biodegradation presumably by microbial activity in the guts of the animals. However, Serripes pregerentially retained the high-molucular-weight saturated hydrocarbon assemblage as well as the higher alkylated naphthalene, phenanthrene and dibenzothiophene compounds, whereas Mya depurated all hydrocarbon components although the water-soluble alkyl benzenes and naphthalenes were depurated somewhat faster. However, the deposit feeders continued to accumulate oil from the sediments, at least for the two weeks after the spill.

42996 **(PB—87-200077/XAB) South Atlantic OCS (Outer Continental Shelf) Circulation Model, Phase 3 (revised). Final report.** Kantha, L.H.; Herring, H.J.; Mellor, G.L. (Dynalysis of Princeton, NJ (USA)). Dec 1986. 171p. (DYNALYSIS—91). NTIS, PC A08/MF A01.

The primary research activity in the present study is to demonstrate that the General Circulation Model embodies the physics required to produce the observed Gulf Stream variability. The results show that given adequate grid resolution and appropriate boundary conditions the model does produce qualitatively realistic shingles and intrusions along the western boundary of the Gulf Stream. Another important component of the study is to provide circulation fields for immediate application to satisfy Minerals Management Service oil-spill modeling requirements. Climatological distributions of the various water-mass characteristics, wind stresses, and heat fluxes have been produced. The domain for which data have been analyzed encompasses the coastal waters of the east coast of the United States.

42997 **(PB—87-200085/XAB) Computer simulation of the probability that endangered whales will interact with oil spills.** Reed, M.; Jayko, K.; Bowles, A.; Anderson, E.; Leatherwood, S. (Applied Science Associates, Inc., Narragansett, RI (USA)). Mar 1987. 303p. (ASA—84-35). NTIS, PC A14/MF A01.

Supersedes PB—87-121307.

A numerical model system was developed to assess quantitatively the probability that endangered bowhead and gray whales will encounter spilled oil in Alaskan waters. Bowhead and gray whale migration and diving-surfacing models, and an oil-spill trajectory model comprise the system. The migration models were developed from conceptual considerations, then calibrated with and tested against observations. The movement of a whale point is governed by a random walk algorithm which stochastically follows a migratory pathway. The oil-spill model, developed under a series of other contracts, accounts for transport and spreading behavior in open water and in the presence of sea ice. Historical wind records and heavy, normal, or light ice cover data sets are selected at random to provide stochastic oil-spill scenarios for whale-oil interaction simulations.

42998 **(PB—87-204392/XAB) Determination of hydrocarbon emissions from oil-field-production sump; evaluation report.** Castronovo, C.L. (California State Air Resources Board, Sacramento (USA). Stationary Source Div.). Dec 1986. 153p. (ARB/SS—87-05). NTIS, PC A08/MF A01.

Hydrocarbon emissions from seven oil-field-production sumps were determined using a flux box draft-test method developed by the Engineering Evaluation Branch of the California Air Resources Board. The method involves drawing a measured amount of air through the open face of an open-bottom containment vessel which is floated on the sump. The total hydrocarbon and methane concentrations of the air entering and leaving the containment vessel are determined using both continuous analyzer and Tedlar bag sample analysis techniques. The field tests took place during the spring and summer of 1986 in Kern County, California. The sumps tested were characterized as primary, secondary or tertiary sumps as defined by their stage in the oil-water separation process. Average emission rates were found to range from 4.6 times ten to the sixth power to 186 x ten to sixth power lbs/min/sq. ft. Calculated daily emissions from individual sumps ranged from 26 to 1080 lbs/day. Because of known and unknown factors causing variability in the data, it is not recommended that an overall average emission factor be applied to predict hydrocarbon emissions from oil field production sumps.

42999 **(PB—87-205134/XAB) Marine gas oil in arctic shoreline sediments.** Sveum, P. (SINTEF, Trondheim (Norway)). 9 Dec 1986. 52p. (STF—21-A86105). NTIS, PC PC E04/MF E04.

88000 litres of marine gas oil was accidentally spilled from the storage tanks in Ny-Alesund, Spitsbergen. The oil-contaminated shoreline was treated with the oil-soluble fertilizer INIPOL. Both the oil biodegradation, microbial development and physical removal of the oil were studied. The total level of oil contamination decreased about 90% during less than one year.

0220 Transport, Pipelines, And Handling

43000 **(FRNC-TH—2077) Design and manufacture of a multi-sensor device aimed at the automatic operation of a submarine assembly.** Durand, D. (Toulouse-3 Univ., 31 (France)). Jan 1984. 159p. (In French). NTIS (US Sales Only), PC A08/MF A01. File Number DE87753164.

This thesis presents the study of a system destined not only to connect two mechanical parts in a submarine environment but also to recognise their mutual location. This device which is managed by a micro-computer consists of a set of rheographic and ultrasonic sensors which will be fitted under the form of water proof boxes at the end of a pipeline connector.

43001 **(PB—87-916405/XAB) Marine accident report - explosion aboard the US tank barge TTT 103, Pascagoula, Mississippi, July 31, 1986.** (National Transportation Safety Board, Washington, DC (USA). Bureau of Accident Investigation). 27 May 1987. 46p. (NTSB/MAR—87/05). NTIS, PC A03/MF A01.

The National Transportation Safety Board determined that the probable cause of the explosion was the initial high loading rate of the highly volatile low-conductivity gasoline which resulted in the generation and discharge of an electrostatic charge in the flammable atmosphere in the TTT 103's tanks. Contributing to the severity of the damage was the ineffectiveness of the foam-generating monitors which prevented Chevron's emergency response team from containing the fire on the barge before it spread to the wharf.

0230 Properties

REFER ALSO TO CITATION(S) 42952

43002 **(NIPER—187) Research needs for heavy crude processing and utilization.** Wells, J.W.; Anderson, R.P. (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). Aug 1987. Contract FC22-83FE60149. 48p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87001257.

In the future, conventional crudes will not be able to meet the national energy need. At that point, there will be a transition from conventional to alternative crudes. Heavy crudes which are readily available will be utilized first. Because of the volatility of the petroleum market and our net importer status, the US will have little control over the timing of the transition. The current weakness of the domestic petroleum industry and the lack of understanding of heavy crude chemistry and characteristics may complicate the coming transition. The most efficient role for government research in the processing and utilization of heavy crudes is to develop a program which supports the transition in technologies by developing basic data and understanding of heavy crudes. This effort

consists of programs which identify and explore the chemistry of processing heavy crudes, define their general characteristics, and measure thermodynamic properties and design data. In addition, because the nature of the fuels from heavy crudes will be different, other programs should develop an understanding of stability and compatibility and engine performance differences which may result from their utilization. In this document, a series of programs to define and explore each of the research needs are given and discussed. Estimates of program content, timing, and cost are also included. To insure the validity of these conclusions, the finding of this study was reviewed by experts from the refining industry and faculty members from universities knowledgeable about the refining industry. In general, the findings of the survey strongly support the research needs developed in this document. 11 refs., 10 figs.

0240 Storage

REFER ALSO TO CITATION(S) 42988

43003 **(SAND—87-7096) AUTSKED: Revisited.** Sasser, D.W.; Buchanan, D.K. (Creative Computer Services, Albuquerque, NM (USA); Sandia National Labs., Albuquerque, NM (USA)). Apr 1987. Contract AC04-76DP00789. 61p. NTIS, PC E07/MF A01; 1; GPO Dep. File Number DE87013833.

AUTSKED is a FORTRAN program created to automate scheduling of leaching and oil filling of salt caverns at the Strategic Petroleum Reserve. There have been a number of revisions to the AUTSKED program since the first version. This report documents the latest embellishments to the program. 6 refs.

03 NATURAL GAS

0302 Geology And Exploration

REFER ALSO TO CITATION(S) 42981, 42982, 42983, 42984, 42985, 42986, 44112, 44125

0306 Marketing And Economics

43004 **(DOE/EIA—0130(87/05)) Natural gas monthly, May 1987.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). May 1987. 154p. NTIS, PC A08/MF A01 - GPO; 1; GPO Dep. File Number DE87013860.

Current data on natural and supplemental gas consumption, disposition, production, prices, storage, imports, and exports in the United States are provided for each year from 1981 through May 1987 with monthly data for the most recent three years. Some data are also given by state or city; some data are also given for previous years. Operating and financial data for major interstate natural gas pipeline companies, as well as data on filings, ceiling prices, and transportation under the Natural Gas Policy Act of 1978, are also included. Featured article for this month is "US Imports and Exports of Natural Gas - 1986". 6 figs., 33 tabs.

43005 **(DOE/EIA—0130(87/06)) Natural gas monthly, June 1987.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 25 Aug 1987. 133p. NTIS, PC A07/MF A01 - GPO; 1; GPO Dep. File Number DE87014134.

Current data on natural and supplemental gas consumption, disposition, production, prices, storage, imports, and exports in the United States are provided for each year from 1981 through May 1987 with monthly data for the most recent three years. Some data are also given by state or city; some data are also given for previous years. Operating and financial data for major interstate natural gas pipeline companies, as well as data on filings, ceiling prices, and transportation under the Natural Gas Policy Act of 1978, are also included. 11 figs., 43 tabs. (AT)

43006 **(NP—7900935) Natural gas supply assessment '87: Technical report.** (New York Energy Ofice, Albany (USA). Div. of Policy Analysis and Planning). Aug 1987. 56p. Charles R. Guinn, New York State Energy Office, Agency Building No. 2, Empire State Plaza, Albany, NY 12223-0001. File Number TI87900935.

The natural gas industry is undergoing rapid and profound changes. New regulatory approaches are significantly restructuring the traditional functions of, and relationships among, producers, pipelines, distributors and end-users. The roles of federal and state regulators are also being redefined. A more dynamic and complex gas industry is emerging which is characterized by decreased regulation and increased market opportunities. Lower oil prices will accelerate and intensify this development. Natural gas wellhead prices will increasingly be set by market forces dominated by low oil prices. This assessment explores the significance of recent events, analyzes the expected direction of various factors relevant to natural gas planning and policy issues and outlines strategic responses. Where a specific forecast is presented, it can be considered to represent the most likely trend within a range of possibilities. Recent legislative and administrative actions and proposals for deregulating the natural gas industry and a discussion of their implications for the future is presented. That is followed by a review of recent trends in natural gas markets. The next section contains the outlook for future natural gas supplies, prices and markets. That is followed by a description of the forecasting methodology. The final section includes a discussion of strategies for improving the natural gas market.

0308 Environmental Aspects

REFER ALSO TO CITATION(S) 42983, 42994, 42999, 43430, 44108

0309 Artificial Stimulation

REFER ALSO TO CITATION(S) 42981

0320 Transport, Pipelines, And Handling

REFER ALSO TO CITATION(S) 43922

43007 **(DOE/CE/15254—T1) [Therm-a-valve-insulated valve coverings]: Second quarterly report, 01/87 through 03/87.** (Ball (Randell D.), Yukon, OK (USA)). 1987. Contract FG01-86CE15254. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010799.

Field tests are underway of Therm-a-Valve heaters on gas regulators on pipelines. (DLC)

43008 **(DOE/CE/15254—T2) [Therm-a-valve-insulated valve coverings]: First quarterly report, 10/86 through 12/86.** (Ball (Randell D.), Yukon, OK (USA)). 1986. Contract FG01-86CE15254. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010798.

The (electric) Therm-a-Valve was installed on rural regulator stations on gas pipelines. The purpose is to see if this heater can maintain enough heat to regulator body to prevent regulator freeze-off without the catalytic heaters. The first two weeks' test results are given. (DLC)

43009 **(EUR—10974-EN) Analysis of coefficient data relating to the EEC 100 mm orifice plates.** Spencer, E.A.; Bellinga, H.; Kinghorn, F.C.; Marque, D. (Commission of the European Communities, Luxembourg. Directorate General Information Market and Innovation). 1986. 36p. Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities.

BCR information. Applied metrology and reference materials.

Tests have been completed using six plates in an EEC orifice meter run conforming to ISO 5167 and installed in 100 mm pipework. The plate diameter ratios varied from 0.2 to 0.75, and the pipe Reynolds number from 6.5 x 10/sup 3/ to 4.6 x 10/sup 6/.

These tests were carried out between 1980 and 1984 at the National Engineering Laboratory, Scotland, in both water and high pressure air: at Gasunie, The Netherlands, using natural gas, and at Gaz de France, France, also using natural gas. The paper describes the various facilities, the test programme, and the statistical analyses which were carried out to evaluate the best-fit equations for the basic discharge coefficients. It has been found that the coefficients thus obtained are higher than those currently predicted by the ISO 5167 "Stolz" equation and that given in the American Standards. Though the results are still within the uncertainty levels given in the ISO Standard a systematic shift is indicated.

04 OIL SHALES AND TAR SANDS

0404 Oil Production, Recovery, And Refining

REFER ALSO TO CITATION(S) 43010

0405 Properties And Composition

REFER ALSO TO CITATION(S) 42952, 43010, 43011

0409 Waste Research And Management

43010 **(DOE/FE/60177—2396) Inorganic solute profiles of waters related to Rio Blanco oil shale project retort 1.** Poulson, R.E.; Borg, H.M. (Western Research Inst., Laramie, WY (USA)). Mar 1986. Contract FC21-83FE60177. 40p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87014012.

Water samples were taken from the Rio Blanco oil shale project retort 1 site approximately three- and one-half years after the shutdown of the oil recovery phase. Intermittent flooding and pumpdown of the retort occurred in the interval between shutdown and sampling for this study. Waters from within the retort and from downgradient and offsite locations were compared using a battery of analyses for inorganic and general water quality parameters. Inorganic solute species were selected as potential key indicator species if the particular species concentration inside the retort was greater than that outside the retort. Six inorganic parameters were found to qualify as potential key indicators for retort water migration from the site: potassium, lithium, ammonia, fluoride, thiosulfate, and boron. Except for ammonia, these indicators differ from those selected by other researchers at other modified in situ retorting sites. Ion chromatographic techniques were shown to be applicable for five of the six potential key indicators - all except boron which was detected spectroscopically. Low part-per-billion ion chromatographic analyses were demonstrated for lithium and ammonia. Fractional part-per-million ion chromatographic analyses were demonstrated for potassium and fluoride. Thiosulfate detection limits were in the low part-per-million range and only allowed detection of this indicator inside the retort. Five of the indicators (all except thiosulfate) were detected at slightly elevated levels in the Mahogany Zone "B" groove completion of the downgradient well. However, insufficient historical baseline data are available at the low detection levels required to allow positive identification of communication between this well and the retort. The potential for enhancement of sensitivity of the ion chromatographic methods beyond that already achieved for the selected indicators is discusses. 11 refs., 1 fig., 9 tabs.

43011 **(DOE/FE/60177—2410) Leachability of retorted oil shale by strong complexometric agents.** Esmaili, E.; Carroll, R.B. (Western Research Inst., Laramie, WY (USA)). Jan 1985. Contract FC21-83FE60177. 50p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87014160.

Extraction of solid waste materials with complexometric agents may offer a quick and effective method for assessing the potential long-term release of hazardous chemical constituents. Complexometric agent extraction may establish the maximum amount of elements of environmental concern that can be released to the environment and the capability of waste materials to release them. In this study, four samples of directly (DH) and indirectly (IH) retorted oil shales were extracted with deionized-distilled water and strong complexometric agents. The complexometric agent solutions were composed of 0.5M sodium citrate (citrate), 0.05M diethylenetriaminepentaacetic acid (DTPA), and 0.05M ethylenediaminetetraacetic acid (EDTA). The water extracts were very alkaline with pH values ranging from 11.0 to 11.8 for IH extracts and 12.2 to 12.8 for DH extracts. Sodium, chloride, sulfate, and fluoride were the predominant dissolved species in the IH water extracts. The DH water extracts contained mainly sodium, calcium, chloride, potassium, and sulfate. Water-extractable minor and trace elements were aluminum, arsenic, boron, barium, lithium, magnesium, molybdenum, silicon, and strontium. Complexometric extraction released detectable amounts of arsenic, antimony, selenium, lead, vanadium, and zinc. Other elements of environmental concern, including silver, cobalt, chromium, and nickel, were not detected in excess of the limits of quantitation in complexometric extracts. Based upon the analytical results, it was found that the retorted oil shale mineralogy influenced the extracting solution composition, i.e., when comparing the leachates from the IH and DH samples. Also, the complexometric agents hastened the release of certain constituents into solution compared to water extracts. 17 refs., 12 figs., 20 tabs.

43012 **(PB—87-199170/XAB) Aspects of liquid and vapor flow in retorted oil shale.** Brown, G.O.; McWhorter, D.B. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). Jun 1987. 15p. (EPA—600/D-87/185). NTIS, PC A02/MF A01.

Presented at 1986 Eastern Oil Shale Symposium, Lexington, Kentucky, November 19-21, 1986.

This paper describes a new analytical solution for combined liquid and vapor flow with solute transport, in an attempt to ensure proper interpretation of experimental data. The solution shows that the relative magnitude of the separate transport coefficients produces many of the flow features seen in experimental data, and significant liquid transport can occur in regions without apparent solute transport. This development is new and represents a significant addition to understanding solute transport. As such, its methods and results can be applied to other problems in multiple-phase transport and to materials such as high-volume mining wastes and some hazardous waste disposal sites. The paper shows that an earlier analysis by the authors, that a critical water content exists in retorted oil shale below which solute transport ceases, is unjustified.

0410 Environmental Aspects

REFER ALSO TO CITATION(S) 43011

05 NUCLEAR FUELS

REFER ALSO TO CITATION(S) 43253, 43305

0501 Reserves, Exploration, And Mining

REFER ALSO TO CITATION(S) 43305

43013 **(CREGU—1) Uranium deposits spatially related to discordances.** Pagel, M. (ed.). (Societe EURODIF, 92 - Bagneux (France)). Jun 1983. 380p. (In French). (CONF-8210353—). NTIS (US Sales Only), PC A17/MF A01. File Number DE87752247.

From Seminar on uranium deposits spatially related to discordances; Nancy-Brabois, France (26 Oct 1982).

Selected papers were indexed separately.

43014 (CREGU—1, pp 19-32) **Geologic structure of uranium deposits of Saskatchewan.** Pagel, M. (Centre de Recherches sur la Geologie de l'Uranium, 54 - Vandoeuvre-les-Nancy, France; Centre de Recherches Petrographiques et Geochimiques, 54 - Vandoeuvre-les-Nancy, France). Jun 1983. (In French). NTIS (US Sales Only), PC A17/MF A01. File Number DE87752247. (CONF-8210353—).

From Seminar on uranium deposits spatially related to discordances; Nancy-Brabois, France (26 Oct 1982).

In the north of Saskatchewan the precambrian shelf is constituted by a crystalline basement comprising Archean and Aphebian formations partially tectometamorphized during the Hudsonian. The crystalline basement was overlapped in discordance in the North of the Athabasca basin by Martin detritic formation and in the south by the Athabasca detritic formation surmounted locally by Douglas and Carswell formations.

43015 (CREGU—1, pp 35-53) **Geologic environment of uranium deposits in the Pine Creek geosyncline.** Durak, B. (Centre de Recherches sur la Geologie de l'Uranium, 54 - Vandoeuvre-les-Nancy, France). Jun 1983. (In French). NTIS (US Sales Only), PC A17/MF A01. File Number DE87752247. (CONF-8210353—).

From Seminar on uranium deposits spatially related to discordances; Nancy-Brabois, France (26 Oct 1982).

The Pine Creek geosyncline formation and the Alligator Rivers uraniferous area geology are examined. The main uranium deposits: Koongara, Ranger I No. 1 and Narbalek are briefly presented and similarities in these deposits are underlined. The Jabiluka deposit is examined in another paper.

43016 (CREGU—1, pp 59-93) **Jabiluka deposit.** Durak, B. (Centre de Recherches sur la Geologie de l'Uranium, 54 - Vandoeuvre-les-Nancy, France). Jun 1983. (In French). NTIS (US Sales Only), PC A17/MF A01. File Number DE87752247. (CONF-8210353—).

From Seminar on uranium deposits spatially related to discordances; Nancy-Brabois, France (26 Oct 1982).

The deposit is described, it comprises 3 petrographic units: shales of the Cahill formation, of the precambrian era, containing the mineralizations, sterile dolomite and sandstone. Uranium mineral distribution in the discordance, alteration process and formation of uranium oxides are examined.

43017 (CREGU—1, pp 95-113) **Uranium deposit of Cluff D (Saskatchewan). Structural study and petrography.** Ey, F.; Gauthier-Lafaye, F.; Weber, F.; Lillie, F.; Schumacher, F. (Institut de Geologie, 67 - Strasbourg, France; Minatome, 92 - Paris-la-Defense, France; Cogema, 78 - Velizy-Villacoublay, France). Jun 1983. (In French). NTIS (US Sales Only), PC A17/MF A01. File Number DE87752247. (CONF-8210353—).

From Seminar on uranium deposits spatially related to discordances; Nancy-Brabois, France (26 Oct 1982).

Lithology, structure, mineralization, petrography and alterations of the deposit are described. The high content uraniferous mineralization was mined in and open quarry 30-meters deep in 1980 and 1981.

43018 (CREGU—1, pp 117-122) **Mineralogic characteristics of main uraniferous occurrences in the Carswell formation (Cluff Lake, Athabasca).** Ruhlmann, F. (COGEMA, 92 - Chatillon-sous-Begneux, France. Laboratoire Mineralogie). Jun 1983. (In French). NTIS (US Sales Only), PC A17/MF A01. File Number DE87752247. (CONF-8210353—).

From Seminar on uranium deposits spatially related to discordances; Nancy-Brabois, France (26 Oct 1982).

The metallogenetic study of the deposit evidence four uranium peregenesis: 1) uraninite-selenides and sulphides, 2) pitcholendehematte, 3) pitchblende-carbonate and 4) coffinite-sulphides which are described. Different mineralization phenomena occurred but all are hydrothermal. Age of 1200 million years BP for uraninite and 250-300 million years BP for pitchblende are estimated.

43019 (CREGU—1, pp 125-148) **Uranium deposits in the Rouergue (France) basement and its Palezoic overlying beds.** Schmitt, J.M. (Ecole Nationale Superieure des Mines de Paris, 77 - Fontainebleau, France. Centre de Geologie Generale et Miniere). Jun 1983. (In French). NTIS (US Sales Only), PC A17/MF A01. File Number DE87752247. (CONF-8210353—).

From Seminar on uranium deposits spatially related to discordances; Nancy-Brabois, France (26 Oct 1982).

The different mineralization are described: basement, structure, evolution and alteration. The formation of these deposits occurred in two steps: albitization and later clay formation and albite hydrolysis. Mineralizations are enclosed either in metamorphic rocks either in the palezoic cover.

43020 (CREGU—1, pp 151-168) **Mineralization and fluid inclusions of the Roube indice, Brousse-Broquies basin (Aveyron, France).** George, E. (Centre de Recherches sur la Geologie de l'Uranium, 54 - Vandoeuvre-les-Nancy, France). Jun 1983. (In French). NTIS (US Sales Only), PC A17/MF A01. File Number DE87752247. (CONF-8210353—).

From Seminar on uranium deposits spatially related to discordances; Nancy-Brabois, France (26 Oct 1982).

The deposit is described, uranium minerals include automorphic uranium oxides, pitchblende and titanium-uranium minerals. Crystal structure, X-ray diffraction and geochemistry of uranium oxides are examined. Silicification and carbonation are studied by microthermometry in fluid inclusions.

43021 (CREGU—1, pp 171-227) **Mineral concentrations of basic metals related to discordances.** Samson, P. (Minatome, 92 - Paris-la-Defense, France). Jun 1983. (In French). NTIS (US Sales Only), PC A17/MF A01. File Number DE87752247. (CONF-8210353—).

From Seminar on uranium deposits spatially related to discordances; Nancy-Brabois, France (26 Oct 1982).

Factors controlling uranium deposit formation are compared to other ores, especially Pb, Zn and Cu. Ore concentration on discordance is illustrated by some examples.

43022 (CREGU—1, pp 231-249) **Uraniferous preconcentrations.** Pagel, M. (Centre de Recherches sur la Geologie de l'Uranium, 54 - vandoeuvre-les-Nancy, France; Centre de Recherches Petrographiques et Geochimiques, 54 - Vandoeuvre-les-Nancy, France). Jun 1983. (In French). NTIS (US Sales Only), PC A17/MF A01. File Number DE87752247. (CONF-8210353—).

From Seminar on uranium deposits spatially related to discordances; Nancy-Brabois, France (26 Oct 1982).

Models applied to discordance deposit genesis are generally based on superficial or deep leaching of uranium rich metamorphic, granitic or sedimentary rocks. Available data on Saskatchewan North East Australia are compared. They are essentially on geochemistry and accurate mineralogic data are needed.

43023 (CREGU—1, pp 263-274) **Fluid transfer between basement and sedimentary basins.** Pelissonnier, H. (Ecole Nationale Superieure des Mines de Paris, 75, France). Jun 1983. (In French). NTIS (US Sales Only), PC A17/MF A01. File Number DE87752247. (CONF-8210353—).

From Seminar on uranium deposits spatially related to discordances; Nancy-Brabois, France (26 Oct 1982).

The paper concludes that uranium deposit genesis associated to discordances cannot be explained up to now, by fluid transfer between the basement and the sedimentary basins.

43024 (CREGU—1, pp 275-285) **Tectonic survey of deposits related to discordance of the precambrian era.** Ey, F.; Gauthier-Lafaye, F. (CNRS, Centre de Sedimentologie et de Geochimie de la Surface, 67 - Strasbourg, France). Jun 1983. (In French). NTIS (US Sales Only), PC A17/MF A01. File Number DE87752247. (CONF-8210353—).

From Seminar on uranium deposits spatially related to discordances; Nancy-Brabois, France (26 Oct 1982).

Uranium deposits of Alligator River in Australia and of North Saskatchewan are compared. Common points are stratigraphic position, regional metamorphism, associated tectonic structure and importance of hydrothermalism.

43025 (CREGU—1, pp 289-302) **Weathering.** Pagel, M. (Centre de Recherches sur la Geologie de l'Uranium, Vandoeuvre-les-Nancy, France; Centre de Recherches Petrographiques et Geochimiques, Vandoeuvre-les-Nancy, France). Jun 1983. (In French). NTIS (US Sales Only), PC A17/MF A01. File Number DE87752247. (CONF-8210353—).

From Seminar on uranium deposits spatially related to discordances; Nancy-Brabois, France (26 Oct 1982).

Weathering processes of uranium deposits related to precambrian discordances are very important, they produce a redistribution of uranium. Four types of alteration are discussed in this paper: retromorphosis of the basement, superficial alteration, diagenesis and exterior of hydrothermal alterations.

43026 (CREGU—1, pp 305-315) **Mineralization typology.** Pagel, M. (Centre de Recherches sur la Geologie de l'Uranium, 54 - Vandoeuvre-les-Nancy, France; Centre de Recherches Petrographiques et Geochimiques, 54 - Vandoeuvre-les-Nancy, France). Jun 1983. (In French). NTIS (US Sales Only), PC A17/MF A01. File Number DE87752247. (CONF-8210353—).

From Seminar on uranium deposits spatially related to discordances; Nancy-Brabois, France (26 Oct 1982).

Uranium deposits spatially related to precambrian discordances present common mineralogical and geochemical features but also differences which give information on genesis. Uranium minerals described include uraninite, coffinite, brannerite, thucholite. Minerals found with uranium are briefly reviewed.

43027 (CREGU—1, pp 319-329) **Carbonaceous materials associated to precambrian uranium deposits.** Landais, P. (Centre de Recherches sur la Geologie de l'Uranium, 54 - Vandoeuvre-les-Nancy, France; SNEA(P) Centre de Recherches de Pau, 64, France. Departement Geologie). Jun 1983. (In French). NTIS (US Sales Only), PC A17/MF A01. File Number DE87752247. (CONF-8210353—).

From Seminar on uranium deposits spatially related to discordances; Nancy-Brabois, France (26 Oct 1982).

After a review of carbonaceous materials occurrence in different deposits (Witwatersrand, Elliot, Lake, Oklo and Cluff Lake). Chemical analysis, uranium organo-complex formation, NMR /sup 13/C and infrared spectra of samples from Cluff Lake deposit are reported.

43028 (CREGU—1, pp 33-349) **Dating uraniferous mineralizations related to precambrian discordances.** Pagel, M. (Centre de Recherches sur la Geologie de l'Uranium, 54 - Vandoeuvre-les-Nancy, France; Centre de Recherches Petrographiques et Geochimiques, 54 - Vandoeuvre-les-Nancy, France). Jun 1983. (In French). NTIS (US Sales Only), PC A17/MF A01. File Number DE87752247. (CONF-8210353—).

From Seminar on uranium deposits spatially related to discordances; Nancy-Brabois, France (26 Oct 1982).

Study of geochronology and fluid inclusions are of prime importance for elaboration of a genesis model. Geochronologic data, particularly on Saskatchewan, are varied but not always reliable. Also a thorough review is made of bibliographic data prior to discuss the meaning of these dating in a regional context. 32 refs.

43029 (CREGU—1, pp 355-380) **Models proposed for the genesis of uranium deposits related spatially to precambrian discordances.** Pagel, M. (Centre de Recherches sur la Geologie de l'Uranium, 54 - Vandoeuvre-les-Nancy, France; Centre de Recherches Petrographiques et Geochimiques, 54 - Vandoeuvre-les-Nancy, France). Jun 1983. (In French). NTIS (US Sales Only), PC A17/MF A01. File Number DE87752247. (CONF-8210353—).

From Seminar on uranium deposits spatially related to discordances; Nancy-Brabois, France (26 Oct 1982).

The different models for the genesis of U deposits are presented. They are classified in 4 groups (soil alteration, hydrothermal diagenesis, deep magma differentiation and metamorphism). A critical assessment is made for each model. 56 refs.

43030 **(CREGU—3) Uranium distribution and fixation in main types of climatic and stational pedogenesis on crystalline rocks.** Gueniot, B. (Centre de Recherches sur la Geologie de l'Uranium (CREGU), 54 - Vandoeuvre-les-Nancy (France)). Nov 1983. 260p. (In French). NTIS (US Sales Only), PC A12/MF A01. File Number DE87752279.

An experimental and analytical study of uranium behavior in soils and of its distribution was carried out for bioclimatic pedogenesis on crystalline rocks, generally granites. Uranium distribution, and sometimes thorium) is compared to the distribution of tracers of pedogenesis (C, Fe, Al, Si, alkalis, clays). Uranium and thorium behaviour is dependent of pedogenesis and can be leached or concentrated. Various fractions of soil alteration complexes and associated uranium can be isolated by chemical and physical fractionation and fixation sites for U are evidenced, efficiency is tested in-situ. Adsorption is low on clays, fixation is frequent on oxyhydroxides, organic compounds are active for uranium complexation.

43031 (IAEA-TECDOC—412, pp 7-20) **Overview of world thorium resources, incentives for further exploration and forecast for thorium requirements in the near future.** Jayaram, K.M.V. (Department of Atomic Energy, Hyderabad, India. Atomic Minerals Div.). Mar 1987. NTIS (US Sales Only), PC A08/MF A01. File Number DE87702566. (CONF-8512120—).

From International Atomic Energy Agency technical committee on utilization of thorium-based nuclear fuel: current status and perspectives; Vienna, Austria (2 Dec 1985).

Thorium occurs in association with uranium and rare earth elements in diverse rock types. It occurs as veins of thorite, uranothorite and monazite in granites, syenites and pegmatites. Monazite also occurs in quartz-pebble conglomerates, sandstones and fluviatile and beach placers. Thorium occurs along with REE in bastnaesite, in the carbonatites. Present knowledge of the thorium resources in the world is poor because of inadequate exploration efforts arising out of insignificant demand. But, with the increased interest shown by several countries in the development of Fast Breeder Reactors using thorium, it is expected that the demand will increase considerably by the turn of the century. The total known world reserves of Th in RAR category are estimated at about 1.16 million tonnes. About 31% of this (0.36 mt) is known to be available in the beach and inland placers of India. The possibility of finding primary occurrences in the alkaline and other acidic rocks is good, in India. The other countries having sizeable reserves are Brazil, Canada, China, Norway, U.S.S.R., U.S.A., Burma, Indonesia, Malaysia, Thailand, Turkey and Sri Lanka. Considering that the demand for thorium is likely to increase by the turn of this century, it is necessary that data collected so far, globally, is pooled and analysed to identify areas that hold good promise. 21 refs, 6 figs, 2 tabs.

0507 Fuels Production And Properties

REFER ALSO TO CITATION(S) 43038, 44056

43032 **(CONF-870905—1) Design concepts and advanced telerobotics development for facilities in the back end of the nuclear fuel cycle.** Feldman, M.J. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87007011.

From 6. Pacific Basin nuclear conference; Beijing, China (6 Sep 1987).

In the Fuel Recycle Division at the Oak Ridge National Laboratory, a comprehensive remote systems development program has existed for the past seven years. The new remote technology under development is expected to significantly improve remote operations by extending the range of tasks accomplished by remote means and increasing the efficiency of remote work undertaken. Five areas of the development effort are primary contributors to the goal of higher operating efficiency for major facilities for the back end of the nuclear fuel cycle. These areas are the single-cell concept, the low-flow ventilation concept, television viewing, equipment-mounting racks, and force-reflecting manipulation. These somewhat innovative directions are products of a design process where the technical scenario to be accomplished, the remote equip-

ment to accomplish the scenario, and the facility design to house the equipment, are considered in an iterative design process to optimize performance, maximize long-term costs effectiveness, and minimize initial capital outlay. 14 refs., 3 figs.

43033 **(ND-R—1266(D)) The use of spectrophotometry in FBR reprocessing analysis.** Brown, M.L.; Mills, C.L.; Kyffin, T.W. (UKAEA Dounreay Nuclear Power Development Establishment). Sep 1986. 31p. (CONF-850629—15). United Kingdom Atomic Energy Authority Risley, Warrington WA3 6AT. File Number TI87900940.

From International conference on analytical chemistry in nuclear technology; Karlsruhe, F.R. Germany (4 Jun 1985).

Work performed under United States - UKAEA Fast Reactor Exchange Program.

The analysis of plutonium and americium at various stages of fast reactor fuel reprocessing is required for plant control and accountancy purposes. At Dounreay, spectrophotometry is used routinely for the measurement of total plutonium and americium concentrations, of plutonium valency state distributions in aqueous solutions, and of plutonium IV concentration in solvent (TBP/OK) solutions. A new system has recently been introduced using fibre optic light guides to permit 'in situ' measurement, thereby reducing the risk of breach of containment while retaining the advantage of ease of instrument maintenance. The fibre optic spectrophotometer system is controlled by a micro-computer which enables all calculations to be carried out automatically. The performance capabilities for the measurement of plutonium in 1st cycle aqueous raffinates from the PFR fuel reprocessing plant are compared with conventional spectrophotometers. Spectral manipulations and storage are simplified considerably. A novel technique for plutonium valency measurement and americium determination in plutonium solutions has been developed, using spectral stripping. The results obtained using this approach are compared with those obtained by more conventional techniques. 7 refs., 15 figs., 1 tabs.

0508 Spent Fuels Reprocessing

REFER ALSO TO CITATION(S) 43079

43034 **(CEA-CONF—8838) Extraction of lanthanides and actinides (III) by DI-2 ethyl dithiophosphoric acid and DI-2 ethyl hexyl monothiophosphoric acid. Structure of the complexes in the organic phase.** Pattee, D.; Musikas, C.; Faure, A.; Chachaty, C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Genie Radioactif). Sep 1986. 9p. (CONF-860921—9). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752225.

From ISEC '86: international solvent extraction conference; Munich, F.R. Germany (11 Sep 1986).

To operate a trivalent actinide-lanthanide (III) group chemical separation from low pH nitric solutions we studied the extractive properties of the di-2 ethyl hexyl dithiophosphoric acid (HDEHDTP); this bidentate ligand which possesses a sulfur donor atom is a good extractant of soft acids. We so expect a better selectivity for the actinides (III) extraction. We also have investigated extractive properties of di-2 ethyl hexyl monothiophosphoric acid (HDEHTP) for trivalent actinides and lanthanides; HDEHDTP is a bidentate ligand with one oxygen donor atom and so is a better extractant for hard acids like actinides and lanthanides (III); but its selectivity is weak. The addition of TBP (tri-n butyl phosphate) to HDEHDTP deals to strong synergistic organic complexes with a great selectivity for Am(III). We explicited this phenomenon. When the metal is macroconcentrated the organic complexes aggregate and form inverted micelles.

43035 **(CEA-CONF—8839) Extraction of actinides and fission products ions by non-chelating N,N'-tetraalkyldiamides.** Charbonnel, M.C.; Musikas, C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Genie Radioactif). Sep 1986. 7p. (CONF-860921—10). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752226.

From ISEC '86: international solvent extraction conference; Munich, F.R. Germany (11 Sep 1986).

N,N-dialkylmonoamides, are good extractants of metallic ions. They were considered as alternative to TBP in nuclear fuels reprocessing. The present paper deals with the extractive properties of N,N'-tetrabutylglutaramide. N,N'-tetraalkyldiamides of dicarboxylic acids except malonamides do not extract the trivalent actinides and lanthanides from aqueous HNO, solutions probably because there is no favourable ligand conformation to chelate the metallic ions. This feature is interesting for the nuclear fuel reprocessing since the presence of a second amide group could lead to new selectivities and to radiolytic and solvolytic degradation products easier to handle. We will present the investigation results of HNO/ sub 3/ U(VI), Pu(IV) and fission products extraction by TBGA in toluene from HNO/sub 3/ aqueous solution. 5 figs, 6 refs.

43036 **(CEA-CONF—8847) Reprocessing in France. Some aspects of process chemistry.** Chesne, A.; Sauteron, J. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Genie Radioactif). Oct 1986. 13p. (CONF-8609277—1). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752227.

From Gesellschaft Deutscher Chemiker congress; Regensburg, F.R. Germany (29 Sep 1986).

Like any young industry, reprocessing has, from the outset, been the focus of successive improvements to raise it to a satisfactory level of reliability, both in process design and implementation. This paper deals with the chemistry aspect of the process. The subject is obviously too vast to make a complete review, in the time allowed, of process development in French plants and of the research work conducted for improvements. We shall therefore discuss the main guidelines and the development trends, illustrating them with a number of examples.

43037 **(DP-MS—86-190) Uranium decontamination in Purex second plutonium cycle: An example of solvent extraction modeling.** Hsu, T.C. (Savannah River Lab., Aiken, SC (USA)). 1986. Contract AC09-76SR00001. 21p. (CONF-861294—1-Vugraphs). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010166.

From Chemistry department faculty/graduate students seminar; Clemson, SC, USA (4 Dec 1986).

The existing Purex flowsheet used in the second plutonium cycle at the Savannah River Plant (SRP) does not remove uranium from the plutonium stream. To develop new flowsheets for the Purex second plutonium cycle, computer simulation using SEPHIS was used. SEPHIS is an ORNL-developed solvent extraction simulation code. Box-Wilson experimental design was used to select the minimum set of process conditions simulated. The calculated results were plotted into three-dimensional response surfaces by SAS/ Graph (statistical analysis systems). These surfaces provide a broad and complete overview of the responses. Specific ranges of key variables were then investigated. The second series of process simulations identified flowsheets that provide high uranium decontamination while meeting all other key process requirements. The proposed flowsheet consists of modifying the existing 2B bank flowsheet by relocating the feed, increasing the extractant acidity, and adding a scrub stream. The nuclear safety issue was also examined.

43038 (IAEA-TECDOC—412, pp 89-111) **Reprocessing and refabrication of thorium-based fuel.** Zimmer, E.; Ganguly, C. (Kernforschungsanlage Juelich G.m.b.H., Germany, F.R. Inst. fuer Chemische Technologie der Nuklearen Entsorgung). Mar 1987. NTIS (US Sales Only), PC A08/MF A01. File Number DE87702566. (CONF-8512120—).

From International Atomic Energy Agency technical committee on utilization of thorium-based nuclear fuel: current status and perspectives; Vienna, Austria (2 Dec 1985).

In the last decade extensive R and D has been carried out at our institute on the thorium fuel cycle, particularly on reprocessing and refabrication of High Temperature Reactor (HTR) fuel. For reprocessing thorium-based spent fuel, the dual cycle THOREX process has been thoroughly investigated. The study demonstrates that there are no significant differences between the two extraction modes with either acid or acid deficient feed solution. The investigations have also shown that the feed solution of the second extraction cycle need not be acid deficient since the history of zirconium does not play a role for its decontamination. For re-extraction, the original flow-sheet has been changed such that the Th/U partition is already achieved in the first cycle. The formation of a crud pro-

duced by a Th(DBP)/sub 4/ precipitate can thus be avoided. For refabrication of U-233 bearing HTR fuel kernels, the EGT sol-gel process has been developed. The process starts with a solution containing Th(NO/sub 3/)/sub 4/ and UO/sub 2/(NO/sub 3/)/sub 2/. The kernel production is completed in a few steps and besides ammonia and water no other chemicals are necessary. In conjunction with the chemical process, equipment for continuous and remotely controlled operation was developed, e.g. a particle transport system, a belt drier, a sintering furnace, etc. On the basis of the EGT process a gel pelletization route for the production of (Th,U)O/sub 2/ pellets has been developed. Two important changes were necessary for the sol-gel process: the sol must contain carbon black as well as Ca(NO/sub 3/)/sub 2/. The pores remaining after burning off the carbon black improve the compactability and provide for closed porosity in the pellets whereas calcium improves the sinterability. At a pressing load of 350 MPa and a sintering temperature of 1773 K, pellets with a density of >= 96% TD and an excellent microstructure can be produced. 17 refs, 10 figs.

43039 (IAEA-TECDOC—412, pp 113-131) **Operative experience in first campaign for reprocessing of uranium-thorium Elk-River fuel elements.** Candelieri, T. (ENEA, Policoro, Italy. Dept. Ciclo del Combustible). Mar 1987. NTIS (US Sales Only), PC A08/MF A01. File Number DE87702566. (CONF-8512120—).

From International Atomic Energy Agency technical committee on utilization of thorium-based nuclear fuel: current status and perspectives; Vienna, Austria (2 Dec 1985).

The main characteristics which differentiates the ITREC pilot plant from the other reprocessing plants are summarized. The report describes: a brief history of the Uranium-Thorium Cycle Program developed in Italy since 1960; the results obtained during the cold tests in the Remote Refabrication Cell until 1974, year in which these activities have been stopped; the operating experience in the Campaign for reprocessing of 20 Uranium-Thorium Elk-River irradiated fuel elements. In particular the results of the following operations are described: dismantling fuel elements and pool water treatment, chopping, dissolution, extraction in a Thorex acid-deficient flow-sheet. Some works of maintenance and modification during hot operations (dismantling machine, replacement of the high level waste evaporators) are also presented. The planned utilization of the ITREC plant is indicated. 7 figs, 3 tabs.

0509 Transport And Storage

43040 (DOE/OR/00033—T326) **Monitored retrievable storage of spent nuclear fuel.** Yuracko, K.L. (Massachusetts Inst. of Tech., Cambridge (USA)). Jun 1987. Contract AC05-76OR00033. 499p. Massachusetts Institute of Technology, 77 Massachusetts Ave., Cambridge, MA 02139. File Number TI87013903.

A computer simulation of the US spent fuel management system was used to evaluate alternative decisions regarding Monitored Retrievable Storage (MRS). The model developed tracks spent fuel from generation at individual reactors through final decommissioning of two geologic repositories, and computes the costs and health and safety impacts of each scenario. The reference case in which rod consolidation is not performed at the reactors, and several scenarios involving reactor rod consolidation, improved transportation systems and modified MRS designs were evaluated. The Integral MRS is found to be most attractive for the reference system design, and it becomes more attractive as the repository program is delayed. If the first repository begins operation before 2003, the Integral MRS reduces the risk to the public compared with a system without an MRS, but increases total system cost and occupational risk. However, if the repository begins operation after 2003, the Integral MRS reduces the system cost as well as the public risk. Improvements to the overall system design make the MRS proposal significantly less attractive. If rod consolidation is performed at the reactors, the inclusion of an Integral MRS in the system will increase the tctal system cost. Furthermore, if heavy-haul vehicles or barges are used to transport casks to a nearby railhead for reactors lacking rail access, or dry cask transfers are used at reactors lacking rail cask loading capability, the Integral MRS will increase public risk. The MRS proposal is improved by removing the 15,000 MTU storage capacity limit. This restriction will be costly in the event of delays in the repository program.

43041 (NUREG/CR—4982) **Severe accidents in spent fuel pools in support of generic safety, Issue 82.** Sailor, V.L.; Perkins, K.R.; Weeks, J.R.; Connell, H.R. (Brookhaven National Lab., Upton, NY (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor and Plant Systems). Jul 1987. Contract AC02-76CH00016. 154p. (BNL-NUREG—52093). NTIS, PC A08/MF A01 - GPO. File Number TI87013442.

This investigation provides an assessment of the likelihood and consequences of a severe accident in a spent fuel storage pool - the complete draining of the pool. Potential mechanisms and conditions for failure of the spent fuel, and the subsequent release of the fission products. are identified. Two older PWR and BWR spent fuel storage pool designs are considered based on a preliminary screening study which tried to identify vulnerabilities. Internal and external events and accidents are assessed. Conditions which could lead to failure of the spent fuel Zircaloy cladding as a result of cladding rupture or as a result of a self-sustaining oxidation reaction are presented. Propagation of a cladding fire to older stored fuel assemblies is evaluated. Spent fuel pool fission product inventory is estimated and the releases and consequences for the various cladding scenarios are provided. Possible preventive or mitigative measures are qualitatively evaluated. The uncertainties in the risk estimate are large, and areas where additional evaluations are needed to reduce uncertainty are identified.

43042 (ORNL/RSIC—48, pp 57-68) **Shielding calculation techniques used in the design of fuel storage systems.** Wang, S.S.; Massey, J.V. (Nutech, Inc., San Jose, CA). Sep 1986. NTIS, PC A08/MF A01. File Number DE87002165. (ANS/SD—86/17).

In Approximate calculational techniques for radiation protection applications (collection of papers presented at the November 1985 American Nuclear Society meeting).

This paper addresses the shielding design and analysis of a concrete modular spent fuel storage system. Particular attention is given to comparing various computation techniques in determining bulk shielding thickness, and also in dealing with the radiation streaming effect through the air exit penetration openings in the module. Three computer codes QADMOD, ANISN, and DOT-IV were used to solve the same problem. In addition, hand albedo calculation were done to augment the result of the QADMOD calculation to properly deal with the surface scattering.

43043 (ORNL/RSIC—48, pp 145-156) **Offsite dose evaluation of an independent spent fuel storage installation with a personal computer.** Smith, M.L.; Soong, P.Y.; Watson, L.S. (Virginia Power, Richmond). Sep 1986. NTIS, PC A08/MF A01. File Number DE87002165. (ANS/SD—86/17).

In Approximate calculational techniques for radiation protection applications (collection of papers presented at the November 1985 American Nuclear Society meeting).

Virginia Power plans to build an Independent Spent Fuel Storage Installation (ISFSI) at the Surry Power Station site. Spent fuel, five years or older, will be stored in dry casks which, in turn, will be placed out of doors on concrete pads at the ISFSI. It is anticipated that four casks of spent fuel will be produced each year. The ISFSI may eventually contain a total of 84 casks on three concrete pads, which are located near an existing low level waste facility (LLWF) building at Surry.

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REFER ALSO TO CITATION(S) 43319, 43650, 43703, 44054

43044 (BMI/ONWI—645) **Quarterly brine migration data report, October-December 1984: Nuclear waste repository simulation experiments (brine migration), Asse Mine of the Federal Republic of Germany.** Eckert, J.L.; Kalia, H.N.; Coyle, A.J. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Jul 1987. Contract AC02-83CH10140. 264p. NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE87012853.

Test equipment, the Asse Salt Mine, and the pretest properties of the salt in the test gallery are described including data for

the first 19 months of operations on brine migration rates, borehole pressure, salt temperatures, and thermomechanical behavior of the salt. Primary objectives of the brine migration tests are to: observe the migration of water in salt at the Asse Mine; qualify the test methods and equipment for obtaining brine-migration-related data that support the validity of numerical models for potential US and FRG repository sites; observe borehole conditions such as radiolysis, corrosion, gas generation, pressure, and other synergistic effects resulting from the arrival of brine water; and observe the thermomechanical behavior of salt in the presence of heat, brine, and radiation to support and refine finite-element methods of predicting room closure and other thermomechanical behaviors of salt. 2 refs., 119 figs., 92 tabs.

43045 **(CONF-870653—1) Tumulus Disposal Demonstration Facility for the Oak Ridge Reservation.** Clapp, R.B.; van Hoesen, S.D. (Oak Ridge National Lab., TN (USA)). 28 Jun 1987. Contract AC05-84OR21400. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011669.

From A critical path in developing low-level radioactive waste disposal facilities; Boston, MA, USA (29 Jun 1987).

This disposal concept is based on the Tumulus design developed by the French at the La Manche facility. Waste units are stacked above-grade on a concrete pad. The facility currently under development at the Oak Ridge National Laboratory (ORNL) involves sealing waste in concrete vaults, placing the vaults on a grade level concrete pad, and covering the pad and vaults with a soil cover after vault emplacement is complete. Emplacement is expected to continue until the facility exhausts its approximate 800 m^3 (28,000 ft^3) capacity. The facility incorporates engineered barriers to radionuclide migration; a monitoring system to ensure barrier performance; and a newly developed set of Demonstration Waste Acceptance Criteria to reduce the likelihood of groundwater contamination.

43046 **(CONF-870767—1) Stratabound pathways of preferred groundwater flow: An example from the Copper Ridge Dolomite in East Tennessee.** Lee, R.; Ketelle, D. (Oak Ridge National Lab., TN (USA)). 14 Jul 1987. Contract AC05-84OR21400. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011127.

From Focus on eastern regional ground water issues; Burlington, VT, USA (14 Jul 1987).

The Copper Ridge Dolomite of the Upper Cambrian Knox Group underlies a site at Oak Ridge, Tennessee under consideration by the Department of Energy (DOE) for a below ground waste disposal facility. The Copper Ridge was studied for DOE to understand the influence of lithology on deep groundwater flow. Three facies types are distinguished which comprise laterally continuous, 1 to 4 m thick rock units interpreted to represent upward-shallowing depositional cycles having an apparently significant effect on groundwater flow at depth. Rock core observations indicate one of the recurring facies types is characterized by thin to medium-bedded, fine-grained dolostone with planar cryptalgal laminae and thin shaley partings. Distinctive fracturing in this facies type, that may have resulted from regional structural deformation, it considered to be responsible for weathering at depth and the development of stratabound pathways of preferred groundwater flow. In addition, geophysical data suggest that one occurrence of this weathered facies type coincides with an apparent geochemical interface at depth. Geophysical data also indicate the presence of several fluid invasion horizons, traceable outside the study area, which coincide with the unweathered occurrence of this fine-grained facies type. The subcropping of recurrent zones of preferred groundwater flow at the weathered/unweathered interface may define linear traces of enhanced aquifer recharge paralleling geologic strike. Vertical projection of these zones from the weathered/unweathered rock interface to the ground surface may describe areas of enhanced infiltration. Tests to determine the role of stratigraphic controls on groundwater flow are key components of future investigations on West Chestnut Ridge. 14 refs., 13 figs.

43047 **(CONF-870859—3) Magnetic separation of uranium from magnesium fluoride.** Hoegler, J.M. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012938.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

The attraction or repulsion of particles by a magnetic gradient, based on the respective susceptibilities, provides the basis for physical separation of particles that are comprised predominantly of uranium from those that are predominantly magnesium fluoride (MgF_2). To determine the effectiveness of this approach, a bench-scale magnetic separator from the S.G. Frantz Co., Inc. was used. In the Frantz Model L-1, particles are fed through a funnel onto a vibration tray and through a magnetic field. The specific design of the Frantz magnet causes the magnetic field strength to vary along the width of the magnet, setting up a gradient. The tray in the magnetic field is split at a point about half way down its length so that the separated material does not recombine. A schematic is presented of Frantz Model L-1 CN - the same magnet configured for high gradient magnetic separation of liquid-suspended particles. Here different pole pieces create a uniform magnetic field, and stainless steel wood in the canister between the pole pieces creates the high gradient. 1 ref., 6 figs., 2 tabs.

43048 **(CONF-870859—4) Issues in prioritization for remedial action at ORNL.** Kocher, D.C.; Trabalka, J.R. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87013187.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

A primary goal of the remedial action program at Oak Ridge National Laboratory is to effect closure of existing sites of contamination by radioactive material so that public health will be protected now and in the future. An important aspect of planning for remedial action is assessing programmatic priorities. Two types of remedial actions can be the imposition of institutional controls over contaminated sites and cleanup and closure of sites to an extent sufficient to ensure protection of public health in the absence of institutional controls. Current efforts in prioritizing remedial action sites at ORNL have focused principally on identifying broad issues that must be addressed in developing remedial action strategies. This paper briefly discusses the regulatory and institutional issues of importance to the development of remedial action strategies; a preliminary assessment of radiation doses associated with current levels of radioactivity at contaminated sites and their environs, which can provide useful information on the need for and most appropriate types of remedial action; and data and modeling needs for prioritization and their relationship to different options for program planning. 7 refs.

43049 **(CONF-8702104—1) Environmental compliance considerations for the management of cultural resources.** Curtis, S.A.; Whitfield, S.; McGinnis, K. (Argonne National Lab., IL (USA); USDOE Richland Operations Office, WA; Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). 1987. Contract W-31109-ENG-38. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011489.

From Environmental issues conference; Santa Fe, NM, USA (26 Feb 1987).

This paper examines three key considerations underlying the programmatic management of cultural resources that may be affected by a large federal project. These considerations are statutory background and the compliance process, cultural resource compliance tasks, and quality assurance. The first consideration addresses the legal requirements and steps that must be met and taken for federal agencies to fulfill their cultural resource compliance responsibilities. The second consideration focuses on the tasks that must be performed by technical specialists to facilitate related federal and state compliance actions. The third consideration ensures that compliance requirements are being properly fulfilled. In the technical literature and compliance planning, archaeological and historic sites and Native American cultural resources are grouped under the general heading of cultural resources. Also included under this heading are the traditions and resources of Folk societies. Cultural resources encompass both material and nonmaterial aspects of our cultural heritage and include buildings, structures, objects, sites, districts, archaeological resources, places of religious importance, and unique, distinctive, or unusual lifeways. For compliance purposes, it is

useful to treat these resources within four roughly chronological culture-historical periods: prehistoric, ethnohistoric, historic, and contemporary. 6 refs., 6 tabs.

43050 **(DOE/AL/33218—T9) [Analysis of transportation issues]: Tenth bi-monthly report, March-April 1987.** (Western Interstate Energy Board, Denver, CO (USA)). 27 May 1987. Contract AC02-85AL33218. 102p. NTIS MF A01; 2; GPO Dep. File Number DE87009832.

Following is a synopsis of the status of the completion of all tasks under the contract. During this reporting period, the contractor began work on the fourth set of Primer updates. No new updates were issued over the past two months. A major activity conducted during this reporting period was the completion of a strategic planning exercise by the contractor's High-Level Radioactive Waste Committees at its April 8-9 meeting in Denver, Colorado. The exercise, which was begun in September 1986, resulted in working documents to aid in identifying study priorities for the Committee and to guide the Committee's future work.

43051 **(DOE/CH/10262—T1) Red Lake Band of Chippewa Indians response to the draft area recommendation report.** (Red Lake Band of Chippewa Indians, Red Lake, MN (USA)). 15 Apr 1986. Contract FG02-86CH10262. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008526.

The statement of Little Rock, a Chief of the Red Lake Band of Chippewa Indians, provides the genesis of the Red Lake Band of Chippewa Indian's response to the Department of Energy's efforts to establish a nuclear waste repository on lands ceded under the Treaty of 1863. Of paramount interest to the Red Lake Band of Chippewa Indians are the unresolved issues of hunting and fishing rights, promised in the Treaty negotiations of 1863 and still unresolved to the satisfaction of Tribal members. Comments pertaining to the draft Area Recommendation Report will address the potential impact of a high-level nuclear repository on the human and natural resources of the Red Lake Band of Chippewa Indians. Sociocultural factors of economics and family displacement and traditional beliefs, combined with potential hazards to natural habitats of wildlife, will be analyzed and synthesized for applicable conclusions. 18 refs., 4 tabs.

43052 **(DOE/ID/12584—9) Uranium reference materials.** Donivan, S.; Chessmore, R. (UNC Geotech, Grand Junction, CO (USA)). Jul 1987. Contract AC07-86ID12584. 11p. (UNC/GJ—36-TMC). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013579.

The Technical Measurements Center has prepared uranium mill tailings reference materials for use by remedial action contractors and cognizant federal and state agencies. Four materials were prepared with varying concentrations of radionuclides, using three tailings materials and a river-bottom soil diluent. All materials were ground, dried, and blended thoroughly to ensure homogeneity. The analyses on which the recommended values for nuclides in the reference materials are based were performed, using independent methods, by the UNC Geotech (UNC) Chemistry Laboratory, Grand Junction, Colorado, and by C.W. Sill (Sill), Idaho National Engineering Laboratory, Idaho Falls, Idaho. Several statistical tests were performed on the analytical data to characterize the reference materials. Results of these tests reveal that the four reference materials are homogeneous and that no large systematic bias exists between the analytical methods used by Sill and those used by TMC. The average values for radionuclides of the two data sets, representing an unbiased estimate, were used as the recommended values for concentrations of nuclides in the reference materials. The recommended concentrations of radionuclides in the four reference materials are provided. Use of these reference materials will aid in providing uniform standardization among measurements made by remedial action contractors. 11 refs., 9 tabs.

43053 **(DOE/NE/44139—35) Supernatant treatment of the final decontamination method for the supernatant treatment system: Progress report for the period March 1982-September 1987.** Borisch, R.R.; Marchetti, S. (West Valley Nuclear Services Co., Inc., West Valley, NY (USA)). Feb 1987. Contract AC07-81NE44139. 63p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87014109.

As part of the West Valley Demonstration Project (WVDP), the PUREX supernatant sored in tank 8D-2 will be partially decontaminated before encapsulation in the final glass form. This report discusses selection of a method for removing Cs-137, the major radioactive ion in the supernatant. The methods considered were electrodialysis; hyperfiltration; precipitation with ferrocyanide, NATPB, and PTA; organic ion exchange using CS-100 and a biologically derived method; chelation using DeVoe/Holbein compositions; and inorganic ion exchange with Durasil, natural zeolites, IE-95 and IE-96 medias. After extensive evaluation of experimental data with process constraints taken into account, the inorganic ion exchange media IE-96 (Linde Ionsiv IE-96 synthetic zeolite) was chosen for cesium recovery. IE-96 was chosen because of high sorption rate, high decontamination factor, ion exchange capacity, and compatibility with the glass formers for borosilicate glass in direct melter feed. This report describes the principal design criteria and the process design developed for use in processing the high-level waste supernatant. 4 refs., 10 tabs.

43054 **(DOE/RW—0128) OCRWM [Office of Civilian Radioactive Waste Management] mission plan amendment with comments on the draft amendment and responses to the comments.** (USDOE Office of Civilian Radioactive Waste Management, Washington, DC). Jun 1987. 517p. NTIS, PC A22/MF A01; 1; GPO Dep. File Number DE87012899.

The US Department of Energy (DOE) published in June 1985 the Mission Plan for the Civilian Radioactive Waste Management Program. That document was to provide an informational basis sufficient to permit informed decisions to be made in carrying out the program. DOE recognized that the Mission Plan would be revised. The first such revision is this amendment, which has been prepared to apprise the Congress of significant recent achievements in the waste-management program, the revised schedule for the first repository, and the intent to postpone site-specific work for the second repository and plans for continuing the technology-development program for the second repository. Included are the DOE's submittal to the Congress of a proposal for the construction of a facility for monitored retrievable storage (MRS) as an integral part of the waste-management system and aspects of the consultation-and-cooperation interactions between the DOE and affected states and Indian tribes. The amendment presents the DOE's considered and informed judgments, based on its actual experience in administering these programs, of the preferred courses and schedules for the national program. 104 refs., 7 tabs.

43055 **(DP-MS—86-212) Health physics aspects of incineration of low level radioactive solvent at the Savannah River Plant.** Strain, C.D. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). 1987. Contract AC09-76SR00001. 16p. (CONF-870705—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012388.

From Annual meeting of the Health Physics Society; Salt Lake City, UT, USA (5 Jul 1987).

This document contains the lecture notes and illustrations used in a presentation at the 1987 Health Physics Society Annual Meeting in Salt Lake City, Utah. Included is a description of the radioactive waste disposal facilities at the Savannah River Plant, South Carolina, and of the current use of this facility in incinerating thousands of gallons of radioactive waste. 12 figs. (TEM)

43056 **(DP-MS—86-213) A model of gas generation and transport within TRU [transuranic] waste drums.** Smith, F.G. III. (Savannah River Lab., Aiken, SC (USA)). 1987. Contract AC09-76SR00001. 19p. (CONF-870306—63). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013044.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

Gas generation from the radiolytic decomposition of organic material contaminated with plutonium is modeled. Concentrations of gas throughout the waste drum are determined using a diffusional transport model. The model accurately reproduces experimentally measured gas concentrations. With polyethylene waste in unvented drums, the model predicts that hydrogen gas can accumulate to concentrations greater than 4 mole percent (lower flammable limit) with about 5 Ci of plutonium. Polyethylene provides a worst case for combustible waste material. If the drum liner is

punctured and a carbon composite filter vent is installed in the drum lid, the plutonium loading can be increased to 240 Ci without generating flammable gas mixtures. 5 refs., 7 figs., 4 tabs.

43057 **(DPSP—84-17-1-Rev.4) Savannah River Certification Plan for newly generated, contact-handled transuranic waste.** Wierzbicki, K.S. (Savannah River Lab., Aiken, SC (USA)). 1 Dec 1986. Contract AC09-76SR00001. 74p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87013048.

This Certification Plan document describes the necessary processes and methods for certifying unclassified, newly generated, contact-handled solid transuranic (TRU) waste at the Savannah River Plant and Laboratory (SRP, SRL) to comply with the Waste Isolation Pilot Plant Waste Acceptance Criteria (WIPP-WAC). Section 2 contains the organizational structure as related to waste certification including a summary of functional responsibilities, levels of authority, and lines of communication of the various organizations involved in certification activities. Section 3 describes general plant operations and TRU waste generation. Included is a description of the TRU Waste classification system. Section 4 contains the SR site TRU Waste Quality Assurance Program Plan. Section 5 describes waste container procurement, inspection, and certification prior to being loaded with TRU waste. Certification of waste packages, after package closure in the waste generating areas, is described in Section 6. The packaging and certification of individual waste forms is described in Attachments 1-5. Included in each attachment is a description of controls used to ensure that waste packages meet all applicable waste form compliance requirements for shipment to the WIPP. 3 figs., 3 tabs.

43058 **(DPST—85-688) Savannah River Laboratory seepage basins: Environmental information document.** Fowler, B.F.; Simmons, R.V.; Bledsoe, H.W.; Looney, B.B. (Savannah River Lab., Aiken, SC (USA)). Dec 1986. Contract AC09-76SR00001. 235p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE87013042.

The basins are located in the northwestern section of the Savannah River Plant in the 700 Area. The four basins are out of service and are awaiting closure. When in operation, the basins received a total of 128,820 m^3 of low-level radioactive wastewater from laboratories located in Buildings 735-A and 773-A. Wastewater with radioactivity less than 100 d/m/mL alpha and/or 50 d/m/mL beta-gamma was discharged to the basins. Low concentrations of radioactive and nonradioactive constituents were found in the sediments beneath the seepage basins and a statistical analysis of monitoring data from the six water-table wells indicates elevated levels of chloride, manganese, and sodium in the groundwater. The closure options considered for the basins are waste removal and closure, no waste removal and closure, and no action. The environmental impact evaluation indicates that the human health risks for all closure options are low. Radioactive risk is dominated by tritium, but there is no significant difference between the closure options because the tritium has leached from the site prior to the closure action. The most significant noncarcinogenic risk results from arsenic. All atmospheric and occupational risks are low. The primary calculated ecological effect is due to direct contact with the basin sediments in the no action option. The relative costs for the various options are $9 million for waste removal and closure, $2.9 million for no waste removal and closure with cap, $2.4 million for no waste removal and closure without cap, and $0.26 million for no action. 36 refs., 27 figs., 98 tabs.

43059 **(DPST—85-706) H-Area Seepage Basins: Environmental information document.** Killian, T.H.; Kolb, N.L.; Corbo, P. (Savannah River Lab., Aiken, SC (USA)). Dec 1986. Contract AC09-76SR00001. 271p. NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE87013041.

The basins contain liquid low-level radioactivity and chemicals from the H-Area separations facility. Wells monitor the water table in the vicinity of the basins and also underlying aquifers to detect any vertical contaminant migration. A statistical analysis of monitoring data from this site indicates elevated levels of chloride, fluoride, manganese, mercury, nitrate, sodium, and total radium in the groundwater. The predominant pathways for human exposure to contaminants are surface, subsurface, and atmospheric transport. Modeling calculations were performed to determine the risks to humans via these pathways for the postulated closure options. Modeling calculations were also performed to determine ecological impacts. The environmental impact evaluation indicates that the relative human health risks for all closure options are low. Tritium, the dominant radionuclide, reached a maximum risk in Year -29 (from 1985) of 2.7E-04 HE/yr. Results of the atmospheric pathway modeling indicate that risks associated with the no action option are 2 or more orders of magnitude greater than the waste removal closure option for both radionuclides and chemicals. Ecological analysis indicates that the choice of closure option has no effect on the maximum surface water quality impacts. Implementation of no waste removal or waste removal closure options would not appreciably accelerate a decline in groundwater outcrop concentrations. 49 refs., 41 figs., 94 tabs.

43060 **(DPST—85-904) Estimation of geochemical parameters for assessing subsurface transport at the Savannah River Plant: Environmental information document.** Looney, B.B.; Grant, M.W.; King, C.M. (Savannah River Lab., Aiken, SC (USA)). Mar 1987. Contract AC09-76SR00001. 74p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87013051.

Geochemical parameter estimates to be used in assessing the subsurface transport of chemicals from Savannah River Plant (SRP) waste sites are presented. Specifically, reference values for soil-solution distribution coefficients, solubility, leach rates, and retardation coefficients are estimated for 31 inorganic chemicals (assuming speciation is governed by reasonable assumptions about controlling variables such as Eh and pH) and 36 organic compounds. Additionally, facilitated transport (the association of chemicals with inorganic and organic ligands or colloids resulting in relatively high mobility) was estimated using field data to derive a fraction of the disposal mass which was assumed to be mobile. Hydrologic parameters such as dispersion coefficient, average moisture content in vadose zone, bulk density, and effective porosity are also presented. The estimates are based on site-specific studies when available, combined with technical literature.

43061 **(EPRI-NP—5099) In-plant testing of radwaste ion-exchange materials: Final report.** Jacob, N.P. (Babcock and Wilcox Co., Lynchburg, VA (USA). Lynchburg Research Center; Electric Power Research Inst., Palo Alto, CA (USA)). Jul 1987. 352p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920525.

Improving the performance of radwaste ion-exchange systems is part of the plant operator's effort to reduce the volume of nuclear waste. This work demonstrates an approach for plant operators to use in evaluating and implementing cost effective radwaste ion-exchange materials. For non-recyclable waste, the selectivity of zeolites or aluminum silicate ion exchangers for cesium can reduce replacement and disposal costs for ion-exchange materials. Zeolites should be considered in conjunction with organic ion-exchange materials for removing cesium from low-level waste liquid. Analytical methods should be developed for determining the chemical form of cobalt and iodine isotopes in the waste. A plant demonstration of an improved ion-exchange process is essential to verify the technical and economic approach used in this project. For recycled waste the economics of using spent condensate polisher resin versus fresh resin in the waste treatment system should be evaluated by plant radwaste operators. A study is recommended to define a decision point as to whether the treatment of waste liquid by ion-exchange or evaporation is more economical. 20 refs., 37 figs., 29 tabs.

43062 **(EUR—10446) Study of the physico-chemical behavior of transuranian elements in radioactive waste repositories.** Vitorge, P.; Billon, A.; Dautel, C.; Michau, O.; Quevrin, M.; Delorme, P.; Berthoud, T.; Mauchien, P. (Commission of the European Communities, Luxembourg). 1986. 171p. (In French, English). NTIS (US Sales Only), PC A08/MF A01. File Number DE87752211.

Transuranian chemistry is being studied in the geochemical context of the geological disposal of radioactive waste. The transuranians considered are plutonium, neptunium and americium. The first part, devoted to the chemistry of these elements in aqueous solutions, consists of a critical compilation of literature data with a

view to resulting in producing the E/sub h/-pH diagrams of transuranians in a complexing environment. The study of the retention by constituents of artificial clay barriers (bentonite and attapulgite) is the subject of the second part. The third part concerns the development of a measurement technique for transuranian elements at trace levels by the thermal lensing method.

43063 **(EUR—10489) Experience of high-level radioactive waste disposal in the Asse Salt mine.** (Commission of the European Communities, Luxembourg). 1986. 263p. (In German). NTIS (US Sales Only), PC A12/MF A01. File Number DE87752212.

This report summarises the results of a comprehensive testing programme about the Asse salt mine with a view to disposal of high-level waste in salt: - Thermophysical in situ tests - Liberation of fluids and gas from heated salt - Accidental flooding situations - In situ deformation measurements - In situ stress measurements - Laboratory rheological testing of salt - Geophysical monitoring - Development of rock mechanics computer codes - Thermo-metamorphic processes in salt.

43064 **(EUR—10490) Retention and radionuclide migration mechanisms in the environment of a radioactive waste repository in granitic formation.** Rancon, D.; Miara, P.; Vinson, J.M.; Petronin, J.C.; Dozol, J.F. (Commission of the European Communities, Luxembourg). 1986. 142p. (In French). NTIS (US Sales Only), PC A07/MF A01. File Number DE87752213.

A laboratory pre-determination of retention mechanisms of radionuclides migrating outside the primary waste containers in repository surroundings was started up. Backfillings materials (clay and sand) as well as granite and its weathering products are concerned here. A method allowing the evaluation of the sorption and desorption of radionuclides of the surfaces of fractures by measuring surface retention coefficients, had initially been started up as well as a laboratory device developed for experiments in a reducing environment. The experiments have consisted of studying the sorbing properties of granite minerals of Auriat and its weathering products and of determining the retention of Np, Pu, AM, CS and Sr on the surface fractures of this granite. The influence of a reducing environment on the behaviour of activities has been studied. Complementary percolation tests have also been carried out on clays, at raised temperature and under irradiation. These experiments have enabled a deeper knowledge of retention mechanisms, the taking of parametric sensitivity measurements and the preparation of elaborating more performing experimental devices which included the parameters needed for a realistic simulation of transfer phenomena.

43065 **(EUR—10502) Deep ocean model penetrator experiments.** Freeman, T.J.; Burdett, J.R.F. (Commission of the European Communities, Luxembourg). 1986. 102p. NTIS (US Sales Only), PC A06/MF A01. File Number DE87752214.

Preliminary trials of experimental model penetrators in the deep ocean have been conducted as an international collaborative exercise by participating members (national bodies and the CEC) of the Engineering Studies Task Group of the Nuclear Energy Agency's Seabed Working Group. This report describes and gives the results of these experiments, which were conducted at two deep ocean study areas in the Atlantic: Great Meteor East and the Nares Abyssal Plain. Velocity profiles of penetrators of differing dimensions and weights have been determined as they free-fell through the water column and impacted the sediment. These velocity profiles are used to determine the final embedment depth of the penetrators and the resistance to penetration offered by the sediment. The results are compared with predictions of embedment depth derived from elementary models of a penetrator impacting with a sediment. It is tentatively concluded that once the resistance to penetration offered by a sediment at a particular site has been determined, this quantity can be used to sucessfully predict the embedment that penetrators of differing sizes and weights would achieve at the same site.

43066 **(EUR—10509) Simulation of the life of a radioactive waste repository at various stages of its evolution. Hydraulic state, before, during and after drilling.** Goblet, P. (Commission of the European Communities, Luxembourg). 1986. 128p. (In French). NTIS (US Sales Only), PC A07/MF A01. File Number DE87752215.

The purpose of this study was to test a methodology of representation of a radioactive waste repository, based on the data collected on the granite Auriat site and on the modelling tools developed around the METIS code. A critical review of the available data is done to assess their utility in a modelling exercise. A two dimensional model of a vertical cross-section covering several kilometers was built, integrating major regional inlets and outlets. Various representations of the results are proposed: piezometric head maps, vertical velocity profiles, flow lines, residence time maps. 3 situations of the rock mass were simulated: - Hydraulic state before the drilling of the galleries: the influence of boundary conditions, as well as of the conductivity field, is studied; the effect of major regional fault zones of high conductivity is examined. A very low correlation is shown between the water flux at repository level and the surface hydrology. Transient situation due to the opening of the galleries: this phase is shown to be probably long compared to the active period of the storage. No unwatering is to be expected in the rock mass. Transient phase after the closure of the site, without the influence of the heat production due to the waste. This exercise allowed us to test the behaviour of the numerical model in situations characterized by a high heterogeneity, and to propose various improvements. New ways of visualizing the results (e.g. flow lines, residence, time maps) were developed.

43067 **(EUR—10585) Effects of natural increase in temperature on clay formations and determination of the course and the effects of geothermal fluids.** Polizzano, C.; Benvegnu, F.; Giannotti, G.; Brandimarte, U. (Commission of the European Communities, Luxembourg). 1986. 25p. (In Italian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752216.

The behaviour of clay cover towards the geothermal fluids rising up to the surface may represent an excellent natural analogue of the potential migration processes from deep waste repositories in clay formations. The ENEA is conducting research in an appropriate area near M. Amiata in southern Tuscany in order to contribute to solving the problem of the expected impermeability of clay formations. Geothermal fields may namely give an opportunity of studying a case of clay behaviour at a scale corresponding to size and time considered in waste disposal. In the considered area a relevant geothermal field is still active. A clay complex represents the impermeable cover of the local geothermal field. Several endogenous phenomena indicate the preferential ways of migrations of fluids from the basement throughout the cover. The data obtained by the present research prove that the upward flow of fluids, is possible only in the points of reduced thickness of the cover where very important faulting or granulometric discontinuity occur. This situation typically occurs at the border and not in the central part of the clay basins.

43068 (GSF—20/86, pp 4-11) **Introduction and problems: Survey of the Hope research project.** Herbert, H.J. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Braunschweig, Germany, F.R. Inst. fuer Tieflagerung). Jul 1986. (In German). NTIS (US Sales Only), PC A13/MF A01. File Number DE87780171. (GSF-T—246; CONF-8510447—).

From Status seminar on the R and D project Hope; Braunschweig, F.R. Germany (31 Oct 1985).

Two main points were stressed in working out the research and development program: Main aim of the project: collecting safety-related geochemical, geomechanical, geophysical and technical information on processes before, during and after flooding of hollows in salt deposits. An important part of the project: development, testing and use of equipment and measurement processes in highly concentrated salt solutions at hydrostatic pressures of between about 3 and 8 MPa.

43069 (GSF—20/86, pp 12-21) **Hope salt mine and its geology.** Struensee, G. von. (Kali und Salz A.G., Kassel, Germany, F.R.). Jul 1986. (In German). NTIS (US Sales Only), PC A13/MF A01. File Number DE87780171. (GSF-T—246; CONF-8510447—).

From Status seminar on the R and D project Hope; Braunschweig, F.R. Germany (31 Oct 1985).

The Hope salt mine consists mainly of salt rocks of Zechstein, but also of the salt sequences of the Upper Red Sandstone and of shell lime. The salt mine can be divided into a greatly faulty outer zone with saddles and a tectonic also greatly stressed inner zone. There is rock of the two triassic salinars between the zones. The potassium salts of the Zechstein were of geological importance.

43070 (GSF—20/86, pp 22-42) **Planning and carrying out the project.** Stoever, W.H.; Hoesslin, U. von. (Kavernen Bau- und Betriebsgesellschaft m.b.H., Hannover, Germany, F.R.). Jul 1986. (In German). NTIS (US Sales Only), PC A13/MF A01. File Number DE87780171. (GSF-T—246; CONF-8510447—).

From Status seminar on the R and D project Hope; Braunschweig, F.R. Germany (31 Oct 1985).

About 1.3 million m/sup 3/ of brine were introduced into the Hope mine by the end of September 1985. In spite of the very tight programme and the faulty infrastructure, the work underground was completed on time. In less than 5 months of the planning and building phase, more than 230 measurement recorders were installed for the four measurement programmes at 16 selected sites. 300 m/sup 3/ of salt rock were broken off for the final building work and 800 tonnes of salt, water and cement and also sealing material, were transported in and used.

43071 (GSF—20/86, pp 43-69) **Description and assessment of data collection.** Kiersten, P.; Posner, G.; Breitenbach, J. (Kavernen Bau- und Betriebsgesellschaft m.b.H., Hannover, Germany, F.R.; HDW Elektronik G.m.b.H., Kiel, Germany, F.R.). Jul 1986. (In German). NTIS (US Sales Only), PC A13/MF A01. File Number DE87780171. (GSF-T—246; CONF-8510447—).

From Status seminar on the R and D project Hope; Braunschweig, F.R. Germany (31 Oct 1985).

For achieving the required measurements, one could only rarely use standard products. Apart from the modification of well-tried equipment, such as measurement systems from oceanography, new systems had to be developed in a very short time for the existing conditions of use, had to be matched to the overall system locally and had to be coupled up to make up a system capable of functioning. From the present day point of view, apart from the regular conditions of use of the measurement systems and the great mechanical load on the cables, a large number of non-technical parameters have to be taken into account in producing the overall system, which had an effect on the technical quality of the system which should not be underestimated.

43072 (GSF—20/86, pp 70-129) **Geochemical investigations and results.** Herbert, H.J.; Sander, W. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Braunschweig, Germany, F.R. Inst. fuer Tieflagerung). Jul 1986. (In German). NTIS (US Sales Only), PC A13/MF A01. File Number DE87780171. (GSF-T—246; CONF-8510447—).

From Status seminar on the R and D project Hope; Braunschweig, F.R. Germany (31 Oct 1985).

The following information can be derived from results so far for a final store: With known mineralogy, precise information can be given on the solution metamorphosis processes to be expected. The previous results of this in-situ experiment have confirmed the theoretical considerations. Sensors were developed and tested, which make possible continuous monitoring under hydrostatic pressure in a final store in the case of incoming solution, i.e. for exploration bores. The collection of physical and chemical parameters in open sections and shafts creates the basis for assessing the effect of backfilling from the chemical point of view.

43073 (GSF—20/86, pp 130-195) **Investigations on microseismic behaviour of a salt mine flooded with caustic soda with the Hope mine as example.** Flach, D.; Heick, C. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Braunschweig, Germany, F.R. Inst. fuer Tieflagerung; Kavernen Bau- und Betriebsgesellschaft m.b.H., Hannover, Germany, F.R.). Jul 1986. (In German). NTIS (US Sales Only), PC A13/MF A01. File Number DE87780171. (GSF-T—246; CONF-8510447—).

From Status seminar on the R and D project Hope; Braunschweig, F.R. Germany (31 Oct 1985).

At least in the first phase, there is a direct connection between the introduction of the caustic soda solution into the mine and the appearance of microseismic events. One can also see that with a nearly constant rate of flooding during the months of May to September 1984, the number of activities occurring daily decreases constantly. Due to measurements in a cavern, there was a stop of flooding in the first half of October. The backfilling at a nearly constant rate again led to a more active phase, compared with the previous period, but not on the scale of the measurements at the start.

43074 (GSF—20/86, pp 196-229) **Geomechanical investigations and results.** Schmidt, M.W.; Meyer, T. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Braunschweig, Germany, F.R. Inst. fuer Tieflagerung). Jul 1986. (In German). NTIS (US Sales Only), PC A13/MF A01. File Number DE87780171. (GSF-T—246; CONF-8510447—).

From Status seminar on the R and D project Hope; Braunschweig, F.R. Germany (31 Oct 1985).

With the planned flooding of the Hope salt mine, it was possible to observe the deformation behaviour of the rock in the vicinity of roadways before, during and after the flooding. Selected measurement crossections were instrumented for this purpose. In doing this one had to consider that no experience was available for in-situ instrumentation in saturated salt solutions to collect data on the geomechanical behaviour of the surrounding rock. One had to fall back on experience of geotechnical instrumentation for the long term observation of selected objects, for example the prototype cave system Asse and the knowledge gained from this. One had to tread new paths on the analogue side and also in the field of local digitising and transmission over long distances. One had to fall back on experience from oceanography.

43075 (GSF—20/86, pp 239-252) **Design, construction and monitoring of sealing work.** Fischle, W.R.; Schwieger, K.; Stoever, W.H. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Braunschweig, Germany, F.R. Inst. fuer Tieflagerung; Kavernen Bau- und Betriebsgesellschaft m.b.H., Hannover, Germany, F.R.). Jul 1986. (In German). NTIS (US Sales Only), PC A13/MF A01. File Number DE87780171. (GSF-T—246; CONF-8510447—).

From Status seminar on the R and D project Hope; Braunschweig, F.R. Germany (31 Oct 1985).

By flooding a worked-out mine, it was possible to test the sealing work on a full scale. The aim is to erect an impermeable, statically secure seal requiring no maintenance. Apart from testing measuring equipment, data were to be obtained for later safety calculations. The measurements are also used to check the computer programs. After a dry period of over a year, flooding started at the beginning of 1985 and so did the testing of the seal and the measuring equipment in caustic soda solution.

43076 (GSF—20/86, pp 253-279) **Calculations accompanying experiments on geomechanics and the sealing work.** Nipp, H.K. (Bundesanstalt fuer Geowissenschaften und Rohstoffe, Hannover, Germany, F.R.). Jul 1986. (In German). NTIS (US Sales Only), PC A13/MF A01. File Number DE87780171. (GSF-T—246; CONF-8510447—).

From Status seminar on the R and D project Hope; Braunschweig, F.R. Germany (31 Oct 1985).

Based on extensive preliminary investigations, a rotation symmetrical calculation model is developed for the calculations accompanying the flooding experiment in the Hope mine. The calculations are done with the aim of being able to estimate the support

behaviour or the sealing work in advance. The calculated forecast includes predictions of: pressure build-up in the Hope seals due to rock convergency and pressure of the caustic soda solution, deformation behaviour of the two support parts of the seal in the experimental period, convergency of the open and flooded roadways. The pre-calculated support of assumptions for the calculations, which have to be checked in situ.

43077 **(GSF—20/86) Investigations of processes relevant to final storage before, during and after flooding of the Hope salt mine. 2. report as of 1-April-1984-31-October-1985.** (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Braunschweig (Germany, F.R.). Inst. fuer Tieflagerung; Kavernen Bau- und Betriebsgesellschaft m.b.H., Hannover (Germany, F.R.)). Jul 1986. 289p. (In German). (GSF-T—246; CONF-8510447—). NTIS (US Sales Only), PC A13/MF A01. File Number DE87780171.

From Status seminar on the R and D project Hope; Braunschweig, F.R. Germany (31 Oct 1985).

Individual sections of the report were abstracted and indexed separately.

43078 **(JAERI-M—87-033) Evaluation of destruction behavior of high-level radioactive waste glass.** Takeda, Tsuneo; Nakamura, Haruo; Niwa, Kunikazu. (Japan Atomic Energy Research Inst., Tokyo). Mar 1987. 93p. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. File Number DE87753004.

The evaluation of destruction behavior of high-level radioactive waste (HLW) glass caused by drop impact and thermal impact is one of the most important items in safety analysis of HLW handling facilities. To evaluate the destruction behavior, a new calculation method is necessary. Therefore, a computer code ADEKAT-G has been developed by using a rigid-body spring model. In this paper, results estimated by ADEKAT-G are summarized in the following problems; (1) Thermal impact under a condition of cooling after vitrification, (2) 9 m free drop in a vertical position on a flat floor, (3) Effects of drop height (0.5 m to 9 m), (4) Free drop on a head of another HLW canister settled in a pit and (5) Corner drop on a flat floor.

43079 **(JAERI-M—87-034) Development of partitioning method. A method of recovering technetium. Part 1.** Yamaguchi, Isoo; Kubota, Masumitsu. (Japan Atomic Energy Research Inst., Tokyo). Mar 1987. 29p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. File Number DE87752972.

A partitioning method has been developed under concepts of separating radioactive nuclides from a high-level liquid waste (HLW) according to their half-lives and radioactive toxicity, and of disposing the waste safely. Chemical behavior of /sup 99/Tc in the partitioning process, which has been developed already in our laboratory, and a chemical method recovering it from HLW were studied with a synthetic HLW containing /sup 95m/Tc because /sup 99/Tc was estimated to be one of the main nuclides to be partitioned from HLW through the assessment in terms of reducing environmental effects in the geologic disposal of a solidified HLW. Experimental results for chemical behavior of Tc in the partitioning process showed that it was hardly extracted in the solvent extraction processes of separating U and Pu with tributyl phosphate (TBP) and Am, Cm and rare earths with di-isodecyl phosphoric acid (DIDPA) and was co-precipitated along with other metal ions in the denitration process with formic acid. Therefore, Tc behavior in the denitration process was studied in detail. Over 98 % of Tc was found to be recoverable as precipitate if HLW containing over 5 x 10/sup -3/ M of platinum group elements was denitrated with formic acid of which concentration in the solution became over 1.8 times that of nitric acid. Over 90 % of Tc, which was recovered as precipitate from the synthetic HLW, was able to be dissolved with hydrogen peroxide. Adoption of this denitration and dissolution process prior to adsorptions of Cs and Sr on inorganic ion exchangers will offer a promising prospect of recovering Tc from HLW without no serious modification in the partitioning process.

43080 **(JAERI-M—87-035) Leaching behavior of simulated high-level waste glass.** Kamizono, Hiroshi. (Japan Atomic Energy Research Inst., Tokyo). Mar 1987. 21p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87752995.

The author's work in the study on the leaching behavior of simulated high-level waste (HLW) glass were summarized. The subjects described are (1) leach rates at high temperatures, (2) effects of cracks on leach rates, (3) effects of flow rate on leach rates, and (4) an in-situ burial test in natural groundwater. In the following section, the leach rates obtained by various experiments were summarized and discussed.

43081 **(JAERI-M—87-040) Overall safety assessment of geological disposal and application of probabilistic assessment.** Nakamura, Haruto; Iijima, Toshinori; Muraoka, Susumu. (Japan Atomic Energy Research Inst., Tokyo). Mar 1987. 31p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. File Number DE87752965.

Principal approach for the overall assessment of geological disposal of high level waste was surveyed and discussed. The discussion includes application of the probabilistic safety assessment and methods to reduce the difficulties in the application were discussed based on the examples of input data and methods proposed in published papers.

43082 **(LBL—23371) Contaminant transport from an array of sources.** Kim, C.L.; Chambre, P.L.; Lee, W.W.L.; Pigford, T.H. (Lawrence Berkeley Lab., CA (USA)). Apr 1987. Contract AC03-76SF00098. 9p. (CONF-870894—1). NTIS, PC A02. File Number DE87011226.

From American Society of Civil Engineers engineering hydrology symposium; Williamsburg, VA, USA (3 Aug 1987).

This document shows analytic solutions to the problem of contaminant dispersion from an array of point sources in a waste disposal site. These solutions are for waste sources in a fluid-saturated porous medium, and may be for isotropic or anisotropic dispersion. The solutions are illustrated through isopleths of contaminants for a planar array of point sources perpendicular to groundwater flow. The concentration fields several meters away from this plane can be approximated by equivalent plane sources. 2 refs., 4 figs.

43083 **(LBL/SRP—23344) Assessment of speciation techniques including the application of photoacoustic spectroscopy.** Bucher, J.; Gehmecker, H.; Edelstein, N. (Lawrence Berkeley Lab., CA (USA)). Aug 1985. Contract AC03-76SF00098. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013960.

This document describes laboratory experiments that compare chromatographic and spectroscopic methods for rapidly characterizing ionic species in detail. These techniques were tested on various radioactive ion systems to develop a rapid, accurate approach to site characterization for use with Remedial Action Programs. Promising techniques were evaluated. 9 refs., 16 figs., 2 tabs.

43084 **(NUREG—1245-Vol.1) Radioactive Waste Management Research Program Plan for high-level waste: 1987.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering). May 1987. 59p. NTIS, PC A04/MF A01 - GPO. File Number TI87900731.

This plan will identify and resolve technical and scientific issues involved in the NRC's licensing and regulation of disposal systems intended to isolate high level hazardous radioactive wastes (HLW) from the human environment. The plan describes the program goals, discusses the research approach to be used, lays out peer review procedures, discusses the history and development of the high level radioactive waste problem and the research effort to date and describes study objectives and research programs in the areas of materials and engineering, hydrology and geochemistry, and compliance assessment and modeling. The plan also details the cooperative interactions with international waste management research programs. Proposed Earth Science Seismotectonic Research Program plan for radioactive waste facilities is appended.

43085 **(NUREG—1274) Review process for low-level radioactive waste disposal license application under Low-Level Radioactive Waste Policy Amendments Act.** Pittiglio, C.L. Jr. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Low-Level Waste Management and Decommissioning). Aug 1987. 19p. NTIS, PC A02/MF A01 - GPO. File Number TI87900951.

This document estimates the level of effort and expertise that is needed to review a license application within the required time. It is intended to be used by the NRC staff as well as States and interested parties to provide a better understanding of what the NRC envisions will be involved in licensing a low-level radioactive waste disposal facility. 5 refs., 3 figs., 1 tab.

43086 **(NUREG/CR—4161-Vol.3) Critical parameters for a high-level waste repository: Volume 3, Salt.** Binnall, E.P.; Wollenberg, H.A.; Benson, S.M.; Tsao, L.; Didwall, E.M. (Lawrence Livermore National Lab., CA (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering). Jul 1987. Contract W-7405-ENG-48. 37p. (UCID—20092-Vol.3). NTIS, PC A03/MF A01 - GPO. File Number TI87011815.

This report covers the identification and prioritization of critical parameters for a repository in bedded salt. A parameter is a physical property whose value helps determine the characteristics or behavior of a repository system. A parameter is considered to be critical if a mistake in its measurement, or the inability to measure it, could lead to a wrong conclusion about the adequacy of a repository. Consideration was given to the relative importance of critical parameters in four specific discipline areas: geomechanics, geology, hydrology, and geochemistry. Relative importance of the parameters was independently considered for each of the four major phases of repository activity: site characterization, site construction, site operation, and site closure and decommissioning. Important activities are determination of hydrologic characteristics and salt dissolution rates, and their long-term monitoring. 169 refs., 1 fig., 8 tabs.

43087 **(ORNL/TM—9883) Investigation of leaching of radionuclides and hazardous materials from low-level wastes at Oak Ridge National Laboratory.** Friedman, H.A.; Kelmers, A.D. (Oak Ridge National Lab., TN (USA)). May 1987. Contract AC05-84OR21400. 65p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87013363.

Leaching of both radioactive contaminants and Resource Conservation and Recovery Act hazardous material contaminants from representative low-level radioactive wastes generated at Oak Ridge National Laboratory was investigated using two different leaching methodologies: the current Environmental Protection Agency (EPA) Toxic Waste Extraction Procedure (EP) and a proposed EPA Toxicity Characteristic Leach Procedure (TCLP). Cesium, both ^{137}Cs and ^{134}Cs, was present in many of the waste samples. The average fraction leached for cesium was only ~0.4. Since much of the cesium handled is in the form of CsCl, the limited leaching observed was surprising. Cobalt, as ^{60}Co, was present in many samples; the fraction leached ranged from about 0.2 to 0.7 for various samples. Strontium, as ^{90}Sr, was present in all but one waste sample. Strontium was readily leached from most samples; this result seemed reasonable because much of the strontium handled at ORNL is in the form of $SrCl_2$. Selenium, present as ^{75}Se, was identified in one-half the samples tested. This observation was surprising because selenium is not currently listed as a radioactive waste component in ORNL low-level wastes. The selenium fraction leached was only ~0.2. Chromium, cadmium, and lead were the only inorganic elements identified in a few waste samples at sufficient concentrations to be of potential environmental concern. In no case, however, did the leach extract exceed the EPA toxicity characteristic limit. For a number of the wastes tested, the proposed TCLP leach methodology was more effective in extracting contaminants than was the current EP method. 11 refs., 4 figs., 19 tabs.

43088 **(PNL—6244) MASBAL: A computer program for predicting the composition of nuclear waste glass produced by a slurry-fed ceramic melter.** Reimus, P.W. (Pacific Northwest Lab., Richland, WA (USA)). Jul 1987. Contract AC06-76RL01830. 129p. NTIS, PC E06/MF A01; 1; GPO Dep. File Number DE87013296.

This report is a user's manual for the MASBAL computer program. MASBAL's objectives are to predict the composition of nuclear waste glass produced by a slurry-fed ceramic melter based on a knowledge of process conditions; to generate simulated data that can be used to estimate the uncertainty in the predicted glass composition as a function of process uncertainties; and to generate simulated data that can be used to provide a measure of the inherent variability in the glass composition as a function of the inherent variability in the feed composition. These three capabilities are important to nuclear waste glass producers because there are constraints on the range of compositions that can be processed in a ceramic melter and on the range of compositions that will be acceptable for disposal in a geologic repository. MASBAL was developed specifically to simulate the operation of the West Valley Component Test system, a commercial-scale ceramic melter system that will process high-level nuclear wastes currently stored in underground tanks at the site of the Western New York Nuclear Services Center (near West Valley, New York). The program is flexible enough, however, to simulate any slurry-fed ceramic melter system. 4 refs., 16 figs., 5 tabs.

43089 **(PNL-SA—14908) Influence of hydrologic factors on leaching of solidified low-level waste forms at an arid site field-scale lysimeter facility.** Jones, T.L.; Skaggs, R.L. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1987. Contract AC06-76RL01830. 39p. (CONF-870511—1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011993.

From 4. international hazardous waste symposium on environmental aspects of stabilization-solidification of hazardous and radioactive wastes; Atlanta, GA, USA (3 May 1987).

Most of the precipitation at the Hanford Site arrives as winter snow; this contributes to a strong seasonal pattern in water storage and drainage observed in the lysimeters. This seasonal pattern in storage corresponds to an annual range in the volumetric soil water content of 11% in late winter to 7% in the late summer and early fall. Annual changes in drainage rates cause pore water velocities to vary annually by nearly two orders of magnitude. Rapid snowmelt and frozen soils in February 1985 caused runoff water from areas adjacent to the lysimeter facility to flood three of the lysimeters. This resulted in a temporary increase in soil water storage, and an additional 5 to 10 cm of drainage for these three lysimeters. Measurable quantities of tritium and cobalt-60 are being collected in lysimeter drainage water. Approximately 30% of the original tritium inventory has been leached from both lysimeters containing samples of this waste form. Cobalt-60 is consistently being leached from five lysimeters representing three of the five waste forms. Total cobalt-60 collected from each of the five lysimeters varies, but in each case is less than 0.1% of the original cobalt inventory of the waste sample. Comparisons of cobalt release among flooded and non-flooded lysimeters show no significant difference caused by the extra drainage.

43090 **(RHO-BW-CR—155-P) Geostatistical estimation of elevations within the Cohassett flow at the reference repository location.** Taylor, H.D. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Jun 1987. Contract AC06-77RL01030. 135p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87013005.

Geostatistical methods are used to estimate positions and associated uncertainties of key horizons in the Cohassett flow to define the probability that repository tunnels for a given design will maintain appropriate vertical distances from either the flow top or flow bottom. Because specific requirements for waste emplacement, haulage, and drainage result in repository tunnels that do not precisely follow the geologic structure, structural attitude and thickness of the Cohassett flow interior are key factors in repository placement. The Cohassett flow structural attitude was estimated by ordinary kriging of top-of-basalt borehole data, thus providing more elevation control than deeper horizons. Estimation standard

deviations were calculated to determine the uncertainty of the estimates. Using these standard deviations and planned repository elevations, an assessment was made as to how well the proposed repository workings would "fit" in the Cohassett flow given an 80% confidence criterion. Regions where the repository did not satisfy the criterion were identified, and can be used to locate sites for additional geologic borehole drilling to reduce uncertainties. Evaluation of optional drilling plans revealed that a combination of deep and shallow boreholes would produce greatest reduction in standard deviations (uncertainty) for a given drilling budget. 4 refs., 24 figs.

43091 **(RHO-BW-SA—658) Geomechanical testing development for the Basalt Waste Isolation Project.** Cramer, M.L.; Dischler, S.A.; Erb, D.B.; Berlin, G.T.; Wittreich, C.D.; Bauer, R.E. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations; Westinghouse Hanford Co., Richland, WA (USA)). Apr 1987. Contract AC06-77RL01030. 13p. (CONF-870625—17). NTIS, PC A02/MF A01; GPO Dep. File Number DE87012639.

From 28. U.S. symposium on rock mechanics; Tucson, AZ, USA (29 Jun 1987).

One component of this project is the development of a geomechanical testing program to support repository design, site characterization, and performance assessment requirements. Geomechanics information includes characteristics of the in situ stress field and the mechanical properties of the rock mass. The nature of the basalts at the proposed repository depth of approximately 970 m imposes some relatively unusual requirements on testing methods typically used to assess the stress state and rock mass deformability. The rock mass is closely jointed, with the spacing estimated from vertical boreholes to be in the range of 5 to 10 cm for both vertical and horizontal joint sets. The ambient temperature at depth is about 50°C. The rock mass is considered fully saturated. This presentation summarizes the development effort currently under way to support site characterization testing to be conducted at the candidate repository horizon in the Exploratory Shaft Facility. Development activities include hydraulic fracturing, overcoring, flat jack testing, and borehole dilatometer testing.

43092 **(RHO-WM-PL—14-P) Hanford Site Transuranic Waste Inventory Work Off Plan.** (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Sep 1986. Contract AC06-77RL01030. 96p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87012652.

This report is one of the disposal alternatives chosen for detailed analysis, thus, the contents are preliminary until the record of decision is received. The Hanford Site transuranic wastes and waste sites included in the scope of this report are the post-1970 retrievably stored and newly generated solid TRU wastes, the pre-1970 TRU buried solid waste, and the transuranic-contaminated soil sites. This report identifies the resources and facilities needed to implement the Rockwell Hanford Operations WIPP certification program and provides a plan for retrieval, processing (if necessary), and certification of retrievably stored and newly generated TRU solid wastes. Current strategies and schedules for work off of the waste and shipment to the WIPP are provided. Detailed descriptions of TRU wastes currently stored and those wastes projected to be stored at the Hanford Site are also presented. Plans for in-place stabilization and disposal of pre-1970 TRU buried solid waste and TRU-contaminated soil sites are presented. 6 refs., 12 figs., 22 tabs.

43093 **(RHO-WM-PL—15-P) Hanford site implementation plan for buried, transuranic-contaminated waste.** (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). May 1987. Contract AC06-77RL01030. 43p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013868.

The GAO review of DOE's Defense Waste Management Plan (DWMP) identified deficiencies and provided recommendations. This report responds to the GAO recommendations with regard to the Hanford Site. Since the issuance of the DWMP, an extensive planning base has been developed for all high-level and transuranic waste at the Hanford Site. Thirty-three buried sites have been identified as possibly containing waste that can be classified as transuranic waste. Inventory reports and process flowsheets were used to provide an estimate of the radionuclide and hazardous chemical content of these sites and approximately 370 additional sites that can be classified as low-level waste. A program undertaken to characterize select sites suspected of having TRU waste to refine the inventory estimates. Further development and evaluation are ongoing to determine the appropriate remedial actions, with the objectives of balancing long-term risks with costs and complying with regulations. 18 refs., 7 figs., 6 tabs.

43094 **(SAND—83-7451) Investigative study of the underground excavations for a nuclear waste repository in tuff: Nevada Nuclear Waste Storage Investigations Project.** St. John, C.M. (Agapito (J.F.T.) and Associates, Inc., Rolling Hills Estates, CA (USA); Sandia National Labs., Albuquerque, NM (USA)). Jul 1987. Contract AC04-76DP00789. 104p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87013121.

Numerical studies were conducted on the behavior of a tuff rock mass within which emplacement drifts for a nuclear waste repository are excavated. The first study evaluated the effects of rockbolting and excavation-induced damage on the behavior of the rock mass round typical drifts. The second study provided a simple means of assessing the significance of drift shape, drift size, and in-situ state of stress on the deformation and stress in the vicinity of drifts for vertical and horizontal emplacement of waste. Neither study considered the effect of heating of the rock mass after emplacement of the waste so the conclusions pertain only to the conditions immediately after excavation of the underground openings. The results of analyses of the rockbolted excavations indicated that rockbolts do not have a significant influence on the states of deformation or stress within the rock mass, and that the rockbolts are subjected to acceptable levels of stress even if installed as close to the face of the excavation as possible. Accordingly, rockbolts were not considered in the study of drift shape, drift size, and the in-situ state of stress. That study indicated that stable openings of the dimensions investigated can be constructed within a tuff rock mass with the properties assumed. Of the parameters investigated, the in-situ state of stress appeared to be most important. Potentially adverse conditions were predicted if the in-situ horizontal stress is very low, but current indications are that it lies within a range which is consistent with good conditions and a stable roof. 28 refs., 49 figs., 11 tabs.

43095 **(SAND—86-1571) Nevada Nuclear Waste Storage Investigations Project: Effect of drift ventilation on repository hydrology and resulting solute transport implications.** Hopkins, P.L.; Eaton, R.R.; Sinnock, S. (Sandia National Labs., Albuquerque, NM (USA)). May 1987. Contract AC04-76DP00789. 49p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013592.

Yucca Mountain, Nevada Test Site, is a proposed location for the underground storage of high-level nuclear waste. The Department of Energy is conducting characterization and analysis of this site through the Nevada Nuclear Waste Storage Investigations (NNWSI) Project. To perform required inspections after waste emplacement, the repository drifts may need to be ventilated for some period of time before access is practical. This report describes a computational investigation undertaken to determine whether cyclic ventilation would cause a reduction in the saturation of the drift walls and adjacent host rock. A significant reduction in saturation near buried waste canisters would prevent advective solute transport. The isothermal study of this ventilation process involved one- and two-dimensional analyses. The 1-D studies provided insight into the effects of ventilation cycling ratios and cycle periods on the removal of moisture from the drift wall. These studies also suggested that the moisture removed during cyclic ventilation over a long period of time can be reasonably represented by constant ventilation. Under the conditions of a 2-D simulation of constant ventilation for 50 years after drift excavation and subsequent recovery period, the fluid velocity field indicates that advective contaminant transport away from emplacement holes could be prevented for a period of 275 to 420 years. The prescribed boundary conditions were varied and the results showed that a decrease in either the prescribed infiltration rate or the relative humidity of the drift ventilation air would increase the time period of enhanced containment. 10 refs., 22 figs., 4 tabs.

43096 **(SAND—86-7167) Modeling of ground-water flow in the Culebra Dolomite at the Waste Isolation Pilot Plant (WIPP) site: Interim report.** Haug, A.; Kelley, V.A.; LaVenue, A.M.; Pickens, J.F. (Intera Technologies, Inc., Austin, TX (USA)). Mar 1987. Contract AC04-76DP00789. 441p. NTIS, PC A19/MF A01; 1; GPO Dep. File Number DE87009387.

This hydrogeologic modeling study has been performed as part of the regional hydrologic characterization of the Waste Isolation Pilot Plant (WIPP) in southeastern New Mexico. The study resulted in an estimation of the transmissivity distribution, hydraulic potentials, flow field, and fluid densities in the Culebra Dolomite Member of the Permian Rustler Formation at the WIPP site. The site characterization studies are being conducted as part of the evaluation of the suitability of bedded salt of the Salado Formation for isolation of defense transuranic waste. The objectives of this report are to document the hydrogeologic data base for the Culebra dolomite at the WIPP site (including Culebra elevations, transmissivities, fluid densities, freshwater heads, and hydrologic stresses during the period 1981 to 1986); develop a conceptualization and modeling strategy for describing ground-water flow in the Culebra; present the calibration approach and results for simulating groundwater flow in the Culebra under undisturbed hydraulic conditions and during the transient period (1981 to 1986) resulting from shaft activities and well tests (in particular, the H-3 multipad pumping test); present the results of sensitivity analyses to assess the impact of vertical fluxes to the Culebra on the freshwater head and fluid-density distributions; and present the results of calculations and analyses to assess the impact of double-porosity flow on the transient behavior of the simulated hydrogeology in the Culebra dolomite. 118 refs., 98 figs., 26 tabs.

43097 **(SKB-TR—85-13) Analysis of hydrodynamic dispersion in discrete fracture networks using the method of moments.** Rasmuson, A. (Swedish Nuclear Fuel and Waste Management Co., Stockholm). 20 Jun 1985. 47p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87780173.

Recent field investigations in crystallline rock give strong indications that water flows in largely isolated channels in fissured rock. The channels are located in fracture planes and may not connect to other channels in the same plane or at fracture intersections. In the present paper, hydrodynamic dispersion in such fracture networks is investigated using the concepts of residence time distribution (RTD) theory. It is shown that, from a set of simple relations, at least the first four statistical moments for the system response are easily obtained even for complicated networks. In particular, an equivalent dispersion coefficient may be calculated from the second central moment (variance). The effect of channeling generally decreases in systems with many mixing steps. A criterion, based on the coefficients of skewmess and kurtosis, is derived for when the response of the system is in accordance with the diffusion-dispersion model. Examples hsow that this limit may not be obtained under realistic repository conditions in fissured rock. With 3 figures and 13 refs. Published in Water Resource Research v.21(11) 1985, p. 1677-1683.

43098 **(SKB-TR—85-14) Radionuclide migration in strongly fissured zones - the sensitivity to some assumptions and parameters.** Rasmuson, A.; Neretnieks, I. (Swedish Nuclear Fuel and Waste Management Co., Stockholm). 7 Aug 1985. 57p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87780172.

Radionuclides escaping from a repository for high level nuclear waste in crystalline rock may eventually be carried by the flowing water in fissure zones. In such zones the rock is blocks of varying sizes and shapes. Also, the water velocity may vary considerably in such zones. A previously developed model which lumps the different blocks into a single PSEUDOBODY is tested by comparing it with an exact analytical solution which can account for the diffusion into blocks of any size distribution. The approximate simplified model which is based on a numerical scheme, and thus is more versatile, gives errors which are small compared to the 'normal' variation in observed block size distributions and other data. A method for determining an 'average' Peclet number (or dispersion length) in a strongly varying velocity field is tested and found to give small errors compared to the present confidence limits in predicting dispersion data for large migration distances. A simple criterion is proposed for defining the cutoff limit in the block size distribution, below which the blocks can be modelled as if they were in equilibrium with the flowing water. A simple sensitivity analysis shows that much can be gained if the confidence limits for block size distribution, water flow rate, dispersion data, sorption data, and matrix diffusion data can be narrowed down. With 15 figures and 23 refs. Published in Water Resources Research Vol. 22(4), 1986, p. 559-569.

43099 **(Y/TS—220/R1) Reduction of low-level radioactive waste at the Oak Ridge Y-12 Plant.** Butcher, B.T.; Simon, K.F. (Oak Ridge Y-12 Plant, TN (USA)). 21 Jan 1987. Contract AC05-84OS21400. 5p. (CONF-8709104—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87012331.

From ANS topical conference on population exposure from nuclear fuel cycle; Oak Ridge, TN, USA (15 Sep 1987).

To reduce low-level radioactive waste volumes, Oak Ridge Y-12 Plant is employing supplemental radiation monitoring of waste streams and has initiated a pilot program for source segregation of waste in the work place. The major stream targeted for waste minimization efforts is combustible solid waste in bulk quantities. Segregation involves concentrating contamination into a smaller volume, thereby reducing controls on disposal of the larger uncontaminated portion.

43100 **(YJT—86-31) Processing of vertical seismic profiles from the Lavia test hole.** Cosma, C.; Heikkinen, P.; Laasonen, K. (Voimayhtioeiden Ydinjaetetoimikunta, Helsinki (Finland)). Nov 1986. 42p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87752415.

The V.S.P. tests were a part of the research program for the final disposal of spent nuclear fuel. The aim has been to study if it is possible to detect by V.S.P. major fractured zones and determine their dimensions and orientation. The present report reviews both the field phase of the tests and the processing work. Small charges were exploded along four shotlines on surface. The number of shot positions was 20. Measurements were done down to 500 m in the borehole. Triaxial detectors and digital recording were used. One of the most powerfull methods developed and tested during this program is a form of multiple slant stacking. Other processing techniques are also reviewed. The main conclusion of this report is that it is possible to detect by V.S.P. reflections from deep fractured zones and to compute the position of the reflectors in three dimensions.

43101 **Role of organics in the subsurface migration of radionuclides in groundwater.** Toste, A.P.; Kirby, L.J.; Pahl, T.R. (Pacific Northwest Lab., Richland, WA 99352). pp 251-270 of Geochemical behavior of disposed radioactive waste. Barney, G.S.; Navratil, J.D.; Schulz, W.W. Washington, DC; American Chemical Society (1984). (CONF-830303—). Contract AC06-76RL01830.

From 185. American Chemical Society national meeting; Seattle, WA, USA (20 Mar 1983).

Research is underway at a commercial shallow-land burial site at Maxey Flats, Kentucky, to identify the chemical forms of migrating radionuclides. An experimental study area, consisting of an experimental slit trench in five sections and a number of inert atmosphere wells, was constructed adjacent to a waste-filled trench to monitor any subsurface migration of radionuclides in groundwater. Research to date indicates that certain radionuclides, /sup 3/H, /sup 238,239,240/Pu, /sup 90/Sr, /sup 60/Co and /sup 137/Cs, have migrated within the study area over relatively short distances (4-7m). The appearance of EDTA and the barbiturates in only one inert atmosphere well argues that communication between the waste-filled area and the experimental study area is very specific, presumably via fracture flow. Radionuclide, inorganic and organic data indicate that the groundwater flow patterns are complex, at least in the vicinity of the experimental study area.

43102 **Uranium mobility in the natural environment: Evidence from sedimentary roll-front deposits.** Deutsch, W.J.; Serne, R.J. (Pacific Northwest Lab., Richland, WA 99352). pp 287-304 of Geochemical behavior of disposed radioactive waste. Barney, G.S.; Navratil, J.D.; Schulz, W.W. Washington, DC; American Chemical Society (1984). (CONF-830303—). Contract AC06-76RL01830.

From 185. American Chemical Society national meeting; Seattle, WA, USA (20 Mar 1983).

Roll-front deposits consist of naturally occurring ore-grade uranium in selected sandstone aquifers throughout the world. The geochemical environment of these roll-front deposits is analogous to the environment of a radioactive waste repository containing redox-sensitive elements during its post-thermal period. The ore deposits are formed by a combination of dissolution, complexation, sorption/precipitation, and mineral formation processes. The uranium, leached from the soil by percolating rainwater, complexes with dissolved carbonate and moves in the oxidizing groundwater at very low concentration (parts per billion - ppb) levels. In this paper data from in-situ leach mining and restoration of roll-front uranium deposits also provide information on the potential mobility of the waste if oxidizing ground water should enter the repository. Uranium solids probably are initially very soluble in carbonate ground water; however, as reducing conditions are re-established through water/rock interactions, the uranium reprecipitate and the amount of uranium in solution again equilibrates with the reduced uranium minerals.

43103 **Effect of aging on the solubility and crystallinity of Np(IV) hydrous oxide.** Strickert, R.G.; Rai, D.; Fulton, R.W. (Pacific Northwest Lab., Richland, WA 99352). pp 135-146 of Geochemical behavior of disposed radioactive waste. Barney, G.S.; Navratil, J.D.; Schulz, W.W. Washington, DC; American Chemical Society (1984). (CONF-830303—). Contract AC06-76RL01830.

From 185. American Chemical Society national meeting; Seattle, WA, USA (20 Mar 1983).

Neptunium(IV) hydrous oxide (NpO/sub 2/ . xH/sub 2/O) was aged in aqueous suspensions with pH values ranging from 4 to 12. Initially amorphous NpO/sub 2/ . xH/sub 2/O developed strong X-ray diffraction peaks within one month that corresponded to crystalline NpO/sub 2/. The oxidation state analyses of the 1.8 nm filtered solutions showed the Np to be primarily present as Np(V). The solubility of NpO/sub 2/ . xH/sub 2/O in suspensions at pH values <8.5 followed the NpO/sub 2/ . xH/sub 2/O $\rightleftharpoons$ NpO/sub 2//sup +/ + e/sup -/ + xH/sub 2/O reaction with an apparent log K° (after 200 days) of -10 +- 1. The results of the aqueous suspensions with pH values >8.5 were complicated by the partial conversion of the NpO/sub 2/ . xH/sub 2/O to an amorphous, oxidized Np solid, and possibly by Np aqueous speciation other than NpO/sub 2/OH°.

0530 Environmental Aspects

REFER ALSO TO CITATION(S) 43044, 43048, 43053, 43054, 43055, 43058, 43059, 43064, 43082, 43087, 43089, 43092, 43093, 43096, 43098, 43101, 43102, 43106, 44025, 44029, 44037, 44042, 44047, 44048, 44051, 44052, 44056, 44220

0540 Health And Safety

REFER ALSO TO CITATION(S) 43048, 43050, 43052, 43056, 43095, 44025, 44047, 44201

43104 **(DOE/ID/12584—7) Comparison of radon and radon-daughter grab samples obtained during the winter and summer.** Karp, K.E. (UNC Geotech, Grand Junction, CO (USA)). Aug 1987. Contract AC07-86ID12584. 31p. (UNC/GJ—29(TMC)). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013847.

The Technical Measurements Center (TMC), under the auspices of the US Department of Energy (DOE) Uranium Mill Tailings Remedial Action (UMTRA) program, is investigating short-term methods for estimating annual average indoor radon-daughter concentrations (RDC). A field study at 40 sample locations in 26 residential structures in Grand Junction, Colorado, was conducted once in the winter and once in the summer. The short-term methods investigated as part of this study include ten-minute radon and radon-daughter grab sampling and hourly RDC measurements. The results of the field study indicate that ten-minute radon grab samples from basement locations are reproducible over different seasons during controlled sampling conditions. Nonbasement radon and RDC grab samples are highly variable even when the use of the location by the occupant is controlled and the ventilation rate is restricted. The grab sampling was performed under controlled occupied conditions. These results confirm that a short-term radon or RDC measurement in a nonbasement location in a house is not a standardized measurement that can be used to infer an annual average concentration. The hourly RDC measurements were performed under three sets of conditions over a 72-hour period. The three sets of conditions were uncontrolled occupied, controlled occupied, and controlled unoccupied. These results indicate that it is not necessary to relocate the occupants during the time of grab sampling. 8 refs., 8 figs., 10 tabs.

43105 **(ORNL/TM—10453) Stontium-90 contamination in vegetation from radioactive waste seepage areas at ORNL, and theoretical calculations of ^{90}Sr accumulation by deer.** Garten, C.T. Jr.; Lomax, R.D. (Oak Ridge National Lab., TN (USA)). Jun 1987. Contract AC05-84OR21400. 60p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87013371.

This report describes data obtained during a preliminary characterization of ^{90}Sr levels in browse vegetation from the vicinity of seeps adjacent to ORNL solid waste storage areas (SWSA) where deer (Odocoileus virginianus) were suspected to accumulate ^{90}Sr through the food chain. The highest strontium concentrations in plant samples were found at seeps associated with SWSA-5. Strontium-90 concentrations in honeysuckle and/or blackberry shoots from two seeps in SWSA-5 averaged 39 and 19 nCi/g dry weight (DW), respectively. The maximum concentration observed was 90 nCi/g DW. Strontium-90 concentrations in honeysuckle and blackberry shoots averaged 7.4 nCi/g DW in a study area south of SWSA-4, and averaged 1.0 nCi/g DW in fescue grass from a seepage area located on SWSA-4. A simple model (based on metabolic data for mule deer) has been used to describe the theoretical accumulation of ^{90}Sr in bone of whitetail deer following ingestion of contaminated vegetation. These model calculations suggest that if 30 pCi ^{90}Sr/g deer bone is to be the accepted screening level for retaining deer killed on the reservation, then 5-pCi ^{90}Sr/g DW vegetation should be considered as a possible action level in making decisions about the need for remedial measures, because unrestricted access and full utilization of vegetation contaminated with <5 pCi/g DW results in calculated steady-state (maximum) ^{90}Sr bone concentrations of <30 pCi/g in a 45-kg buck.

43106 **(PNL—6262) Sampling errors associated with soil composites used to estimate mean Ra-226 concentrations at an UMTRA remedial-action site.** Gilbert, R.O.; Baker, K.R.; Nelson, R.A.; Miller, R.H.; Miller, M.L. (Pacific Northwest Lab., Richland, WA (USA)). Jul 1987. Contract AC06-76RL01830. 59p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87013838.

The decision whether to take additional remedial action (removal of soil) from regions contaminated by uranium mill tailings involves collecting 20 plugs of soil from each 10-m by 10-m plot in the region and analyzing a 500-g portion of the mixed soil for ^{226}Ra. A soil sampling study was conducted in the windblown mill-tailings flood plain area at Shiprock, New Mexico, to evaluate whether reducing the number of soil plugs to 9 would have any appreciable impact on remedial-action decisions. The results of the Shiprock study are described and used in this paper to develop a simple model of the standard deviation of ^{226}Ra measurements on composite samples formed from 21 or fewer plugs. This model is used to predict as a function of the number of soil plugs per composite, the percent accuracy with which the mean ^{226}Ra concentration in surface soil can be estimated, and the probability of making incorrect remedial action decisions on the basis of statistical tests. 8 refs., 15 figs., 9 tabs.

0550 Safeguards, Inspection, And Accountability

REFER ALSO TO CITATION(S) 43919

43107 (GAO/RCED—87-72) Nuclear security: DOE's reinvestigation of employees has not been timely. (General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div.). 10 Mar 1987. 33p. US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877. File Number TI87900943.

Report to the Chairman, Subcommittee on Environment, Energy, and Natural Resources, Committee on Government Operations, House of Representatives.

We found that DOE headquarters and some field offices have been unable to meet DOE goals to reinvestigate security clearances. Clearance reinvestigation are an important element of DOE's security program because they are aimed at identifying employees whose lifestyles raise questions about their eligibility for a clearance. DOE's failure to perform timely reinvestigation has contributed to having cleared employees in its work force who may not be suitable for a clearance because they have serious drug, alcohol, or other problems. DOE needs to develop a plan to ensure that all required reinvestigations are performed on time. Planning should start with a review of the appropriateness of the number and level of active clearances, since these factors largely determine the reinvestigation workload. The plan should then provide for the resources necessary to meet requirements.

43108 (LA-UR—87-2223) Present and future aspects of PROSA: A computer program for near real time accountancy. Beedgen, R. (Los Alamos National Lab., NM (USA); Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Datenverarbeitung in der Technik). Jul 1987. Contract W-7405-ENG-36. 7p. (CONF-870713—41). NTIS, PC A02. File Number DE87013132.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

The methods of near real time accountancy (NRTA) for safeguarding nuclear material received a lot of attention in the last years. We developed PROSA 1.0 as a computer program to evaluate a sequence of material balance data based on three statistical tests for a selected false alarm probability. A new NRTA test procedure will be included and an option for the calculation of detection probabilities of hypothetical loss patterns will be made available in future releases of PROSA. Under a non-loss assumption, PROSA may also be used for the analysis of facility measurement models.

43109 (LA-UR—87-2241) Methodology for materials control and accounting information systems. Helman, P.; Strittmatter, R.B. (New Mexico Univ., Albuquerque (USA). Dept. of Computer Science; Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 8p. (CONF-870713—42). NTIS, PC A02. File Number DE87013133.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

Modern approaches to nuclear materials safeguards have significantly increased the data processing needs of safeguards information systems. Implementing these approaches will require developing efficient, cost-effective designs. Guided by database design research, we are developing a design methodology for distributed materials control and accounting (MC & A) information systems. The methodology considers four design parameters: network topology, allocation of data to nodes, high-level global processing strategy, and local file structures to optimize system performance. Characteristics of system performance that are optimized are response time for an operation, timeliness of data, validity of data, and reliability. The ultimate goal of the research is to develop a comprehensive computerized design tool specifically tailored to the design of MC & A systems.

43110 (NUREG—0904-Suppl.1) Draft supplement to the final environmental statement related to the decommissioning of the Rare Earths Facility, West Chicago, Illinois (Docket No. 40-2061): Kerr-McGee Chemical Corporation. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards). Jun 1987. 489p. NTIS, PC A21/MF A01 - GPO. File Number TI87900832.

This Draft Supplemental Environmental Statement (DSES) assesses the impacts of permanent disposal of wastes located at the Kerr-McGee Rare Earths Facility in West Chicago, Illinois. The assessments presented in the DSES augment and update those described in the Final Environmental Statement (FES) that was issued by the US Nuclear Regulatory Commission (NRC) in May 1983. In this DSES, additional alternative sites are analyzed, the analysis is more detailed, and the NRC expressly considers the suitability of these sites for permanent waste disposal. The analysis describes the Proposed Action, which is permanent disposal of the wastes in an above-grade disposal cell at the West Chicago site, and four alternatives for permanent disposal at other sites in Illinois. The four alternatives are: Alternative A, disposal at an active surface coal mine in a deep-trench disposal cell; Alternative B, disposal in a reclaimed surface coal mine in a deep-trench disposal cell; Alternative C, disposal in an underground coal mine in a worked-out panel; and Alternative D, disposal on a farmland site in a partially above-grade disposal cell. The environmental issues considered in the impact assessment are topography, air quality, socioeconomics, land resources, archaeology, mineral resources, water resources, ecology, and radiation exposure. A cost-benefit analysis of the Proposed Action and its alternatives is also presented. Based on the information and analysis given within this DSES, the NRC concluded that the Proposed Action is the preferred course of action.

43111 (RFP—3948) An electronically enhanced security system using plastic scintillators for special nuclear material detection. Jasper, P.P. Jr. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1987. Contract AC04-76DP03533. 30p. (CONF-870713—43). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013380.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

The Electronically Enhanced Security System at the Department of Energy Rocky Flats Plant (RFP), operated by Rockwell International, in Golden, Colorado includes a Special Nuclear Material (SNM) monitoring system. It was designed by RFP to operate in areas where there is variable radiation background and high volumes of pedestrian traffic. The SNM monitors, or radiometric scanners, using plastic scintillator detectors and microprocessor-based electronics, are placed at the entrance/exit doors of SNM processing areas within production buildings. The Enhanced Security System has numerous areas or posts that are each monitored by the following equipment for alarm detection: plastic scintillators, solid-state color cameras, microwave occupancy detectors, and audio and visual alarmed condition indicators. At centralized guard posts, assessment of an alarm is accomplished by using time-lapse color video cassette recorders, alarm annunciators, an intercom system, dedicated color monitors, and an alarm color monitor. As a pilot program, the Enhanced Security System accomplished a considerable yearly cost savings.

43112 (RFP—4146) Performance criteria: Personnel duties and training. Haas, F.X. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1987. Contract AC04-76DP03533. 7p. (CONF-870713—44). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013385.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

Performance criteria require that a facility handling nuclear material be capable with some degree of probability to detect the theft or diversion of material within a given time interval. Compliance criteria are established for the minimum requirements in materials accounting, materials control and materials measurements. These criteria require levels of excellence from both the monitoring system and the personnel involved in the acquisition and interpretation of input data and response alarms. The duties and training ex-

pected of personnel operating in a safeguards organization are discussed.

43113 **(SAND—87-1128) SIR-1: An autonomous mobile sentry robot.** Harrington, J.J.; Klarer, P.R. (Sandia National Labs., Albuquerque, NM (USA)). May 1987. Contract AC04-76DP00789. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013844.

This paper describes a prototype mobile robot system configured to function as part of an overall security system at a high security facility. The features of this robot system include specialized software and sensors for navigation without the need for external locator beacons or sign posts, sensors for remote imaging and intruder detection, and data link facilities to communicate information either directly to an electronic security system or to a manned central control center. Other features of the robot system include low weight, compact size, and low power consumption. The robot system can operate either by remote manual control, or it can operate autonomously where the need for direct human control is limited to the global command level. The robot can act as a mobile remote sensing platform for visual alarm assessment or roving patrol, or as an exploratory device in situations potentially hazardous to humans. This robot system may also be used to walk-test intrusion detection sensors as part of a routine test and maintenance program for an interior intrusion detection system (IDS), and to provide a programmable, temporary sensor capability to backup an IDS sensor that has failed. This capability may also be used to provide improved sensor coverage of an area that will be secured on a temporary or short term basis, thereby eliminating the need for a permanent sensor installation. The hardware, software, and operation of this robot system will be briefly described herein.

43114 **(UCRL—95626) A new one-detector analysis method for rapid high precision plutonium isotopic measurements.** Gunnink, R. (Lawrence Livermore National Lab., CA (USA)). 28 Oct 1986. Contract W-7405-ENG-48. 7p. (CONF-870519—9). NTIS, PC A02. File Number DE87013560.

From 9. annual meeting of the European Safeguards Research and Development Association: safeguards and nuclear material management; London, UK (12 May 1987).

A new method has been developed that achieves plutonium isotopic analysis precisions of better than 2% in counting times of only a few minutes, using only the 59- to 208-keV energy region of a spectrum. This breakthrough was achieved by developing a unique but highly accurate method for delineating the overall "intrinsic" efficiency curve, including the plutonium K-shell absorption discontinuity at 121 keV. Consequently, the measured 129- and 148-keV peak intensities can now be used to reliably determine the relative abundances of ^{239}Pu and ^{241}Pu. The intense 94- to 104-keV region is also analyzed, providing accurate data for the other isotopes of interest. 5 refs., 3 figs., 2 tabs.

43115 **(UCRL—96045) Validating safeguards effectiveness given inherently limited test data.** Sicherman, A. (Lawrence Livermore National Lab., CA (USA)). 10 Jul 1987. Contract W-7405-ENG-48. 6p. (CONF-870713—47). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013224.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

A key issue in designing and evaluating nuclear safeguards systems is how to validate safeguards effectiveness against a spectrum of potential threats. Safeguards effectiveness is measured by a performance indicator such as the probability of defeating an adversary attempting a malevolent act. Effectiveness validation means a testing program that provides sufficient evidence that the performance indicator is at an acceptable level. Traditional statistical techniques are useful in designing a testing program when numerous independent system trials are possible. However, within the safeguards environment, many situations arise for which traditional statistical approaches may be neither feasible nor appropriate. Such situations can occur, for example, when there are obvious constraints on the number of possible tests due to operational impacts and testing costs. Furthermore, these tests are usually simulations (e.g., staged force-on-force exercises) rather than actual tests, and the system is often modified after each test. Under such circumstances, it is difficult to make and justify inferences about system performance by using traditional statistical techniques. In this paper, we discuss several alternative quantitative techniques for validating system effectiveness. The techniques include: (1) minimizing the number of required tests using sequential testing; (2) combining data from models inspections and exercises using Bayesian statistics to improve inferences about system performance; and (3) using reliability growth and scenario modeling to help specify which safeguards elements and scenarios to test.

43116 **(UCRL—96905) The development and significance of the DOE Safeguards and Security standards and criteria.** Toman, J. (Lawrence Livermore National Lab., CA (USA)). 1987. Contract W-7405-ENG-48. 11p. (CONF-870713—45). NTIS, PC A02. File Number DE87013473.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

In October 1985, the DOE Assistant Secretary for Defense Programs created a task force to develop inspection standards and criteria for Safeguards and Security. These standards and criteria (S/C) would provide the DOE Inspection and Evaluation (I and E) teams with the guidance needed to assess the security posture of DOE's nuclear and other important facilities. The Lawrence Livermore National Laboratory was designated the lead management organization for the structuring, administration, and execution of the overall task force effort and appointed the Executive Secretary. The Office of Security Evaluations (OSE) became the responsible DOE organization, and its Director assumed the role of Chairman of the Task Force Executive Committee. At its peak, the Task Force consisted of approximately 200 people who were considered to be experts in eight major topical areas. The composition of the experts was almost evenly divided between DOE and contractor employees. The collective wisdom of these experts was used in a consensus process to develop the S/C that are now published in draft form. These S/C have been used in more than ten inspections since May 1986 with much success. This paper discusses the process used to achieve the desired end result and the significance of the Task Force's accomplishments.

43117 **(UCRL—96933) Setting priorities for safeguards upgrades.** Al-Ayat, R.A.; Judd, B.R.; Patenaude, C.J.; Sicherman, A. (Lawrence Livermore National Lab., CA (USA)). 10 Jul 1987. Contract W-7405-ENG-48. 7p. (CONF-870713—39). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013225.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

This paper describes an analytic approach and a computer program for setting priorities among safeguards upgrades. The approach provides safeguards decision makers with a systematic method for allocating their limited upgrade resources. The priorities are set based on the upgrades cost and their contribution to safeguards effectiveness. Safeguards effectiveness is measured by the probability of defeat for a spectrum of potential insider and outsider adversaries. The computer program, MI$ER, can be used alone or as a companion to ET and SAVI, programs designed to evaluate safeguards effectiveness against insider and outsider threats, respectively. Setting the priority requires judgments about the relative importance (threat likelihoods and consequences) of insider and outsider threats. Although these judgments are inherently subjective, MI$ER can analyze the sensitivity of the upgrade priorities to these weights and determine whether or not they are critical to the priority ranking. MI$ER produces tabular and graphical results for comparing benefits and identifying the most cost-effective upgrades for a given expenditure. This framework provides decision makers with an explicit and consistent analysis to support their upgrades decisions and to allocate the safeguards resources in a cost-effective manner.

0560 Legislation And Regulations

REFER ALSO TO CITATION(S) 43050, 43054

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

0701 Physical Isotope Separation

43118 **(DOE/ET/33006—006) Plasma separation process: Quarterly technical report for period 1 April 1987 through 30 June 1987.** (TRW Space and Technology Group, Redondo Beach, CA (USA)). 1987. Contract AC03-77ET33006. 122p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87013769.

During the report period the plan and schedule for the Plasma Separation Process program (PSP) closeout was modified to accommodate the use of the production prototype module (PPM) to produce palladium enriched in the isotope Pd 102 from 0.96% to 25%. This material will be irradiated to produce radioactive Pd 103 to be used by the Theragenics Corporation in the treatment of prostate cancer. With a 1 June start of a palladium production operations, the critical path for completion of the closeout program involves the activities associated with decontamination and disassembly of PPM hardware and the delay in magnet warmup will not affect the final closeout schedule. The modified decontamination/disassembly plan accommodates the delays necessitated by the twelve week palladium operation by performing critical tasks in parallel. A summary of the activities carried out during the quarter is given. The top level program plans developed during the quarter are provided in the appendix.

0702 Radiation Sources

REFER ALSO TO CITATION(S) 43699, 43886, 43888

43119 **(JAERI-M—87-047) Study on saccharification of cellulosic wastes with bench scale test plant. (2). Effect of pulverizing on radiation pretreatment of chaff.** Kasai, Noboru; Tamada, Masao; Kumakura, Minoru; Kaetsu, Isao. (Japan Atomic Energy Research Inst., Tokyo). Mar 1987. 16p. (In Japanese). NTIS (US Sales Only), PC A02/MF A01. File Number DE87753003.

The mechanical pretreatment of irradiated chaff for saccharification was studied with the bench scale test plant. Chaff was pulverized by an impact type pulverizer which could treat a large amount of cellulosic wastes in short time. The effect of pulverizing on irradiated chaff was investigated from the point of view of particle size and saccharification. From untreated chaff the low accessibility of enzyme reduces the yield of glucose. Pulverized chaff, however, gave high glucose yield resulting from the increase of the enzyme accessibility because of decrease of particle size. The fine powder of chaff rendered the possibility of the saccharification at the high slurry concentration. The radiation pretreatment with electron beam introduced the decrease of electric energy to obtain the fine powder with pulverizer. This pretreatment also increased the fine powder yield. After irradiation dose increased to more than 70 Mrad in the pretreatment, high glucose concentration was obtained only by coarse pulverizing.

43120 (PPA/SS—10, pp 45-54) **Manufacturing prepainted steel sheet by electron beam curing.** Oka, Joji. (Nippon Steel Corp., Tokyo). Feb 1987. NTIS (US Sales Only), PC A07/MF A01. File Number DE87780152. (CONF-861285—).

From National executive management seminar on industrial radiation curing technology; Kuala Lumpur, Malaysia (8 Dec 1986).

Several advantages are offered by electron beam curing. A formidably hard and stain resistant paint film which is difficult to obtain by heat curing paint is developed. As a result, a unique new prepainted steel is produced. Four technologies are involved: development high-quality paint, selection of optimum electron beam processor, technology to control electron beam processing atmosphere and secondary X-ray shield technology. These technologies are described in detail. (A.J.).

43121 (PPA/SS—10, pp 55-65) **Market potential for the radiation curing technology.** Wildi, J. (Rahn and Co., Switzerland). Feb 1987. NTIS (US Sales Only), PC A07/MF A01. File Number DE87780152. (CONF-861285—).

From National executive management seminar on industrial radiation curing technology; Kuala Lumpur, Malaysia (8 Dec 1986).

The evolution and the growth of radiation curing technology are told in detail. The 1985 consumption of radiation curing systems in United States and Europe are listed in various application fields. Those application fields are: printing inks; adhesives; electronic media; wood; paper/board and plastic coatings and others. The advantages and disadvantages of the technology are also discussed. (A.J.).

43122 (PPA/SS—10, pp 72-74) **UV and EB radiation processing in developing countries.** Garnett, J.L. (New South Wales Univ., Kensington, Australia. School of Chemistry). Feb 1987. NTIS (US Sales Only), PC A07/MF A01. File Number DE87780152. (CONF-861285—).

From National executive management seminar on industrial radiation curing technology; Kuala Lumpur, Malaysia (8 Dec 1986).

The adaptation of radiation processing, the selection and application of UV and EB technologies and also the suitability of the technology for developing countries are determined by the economics, availability of the chemistry and also skilled personnel to service both lines and equipment. (A.J.).

43123 (PPA/SS—10, pp 75-88) **Status of wood-based industries in Malaysia.** Dahlan Haji Mohd. (Unit Tenaga Nuklear, Bangi, Selangor, Malaysia). Feb 1987. NTIS (US Sales Only), PC A07/MF A01. File Number DE87780152. (CONF-861285—).

From National executive management seminar on industrial radiation curing technology; Kuala Lumpur, Malaysia (8 Dec 1986).

Malaysia is one of the biggest suppliers of tropical wood in the world. However, less than 10% of the timber exported have gone through secondary processing. It is high time for this country to concentrate more on the secondary and tertiary sectors with the use of new technology such as radiation curing of coatings, in order to improve the quality of wood products. This paper examines where the strength and potential of the local wood industry lie. 11 refs.

43124 **(UCID—21035) Energy spectra of the pneumatically positioned neutron sources at LLNL's Hazards control standards and calibration facility.** Thorngate, J.H. (Lawrence Livermore National Lab., CA (USA)). 15 Jun 1987. Contract W-7405-ENG-48. 146p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87013573.

The Hazards Control Department of Lawrence Livermore National Laboratory maintains a Standards and Calibration Laboratory that includes three neutron sources (two ^{252}Cf and one ^{238}PuBe that can be positioned pneumatically for irradiations. Ten moderators exist to modify the neutron energy spectra produced by these sources. The thicknesses and materials of these moderators are: 25-cm water; 5-, 10-, 15-, and 25-cm heavy water; 20-cm aluminum; and 2-, 5-, 10-, and 15-cm polyethylene. We used a multisphere spectrometer to measure the neutron spectra at 2 m from both the PuBe source and the smaller Cf source, with the sources bare, and in all of the moderators. These data were reduced in 25 energy groups ranging from 0.25 eV to 16 MeV. Except for the 15-m polyethylene moderator, we also made measurements using a liquid-scintillator fast-neutron spectrometer. These data were reduced in 0.1-MeV increments from 0.5 to 12.5 MeV. Spectra from the measurements and from independent calculations are presented in tabular and graphic form. Dosimetric values, calculated from both the measured and calculated spectra, are also presented.

0704 Economics

REFER ALSO TO CITATION(S) 43121, 43122, 43700

08 HYDROGEN

REFER ALSO TO CITATION(S) 43424

0801 Production

REFER ALSO TO CITATION(S) 43537

43125 **(INIS-mf—10648) Technical and thermodynamic problems of medium-temperature membrane processes, illustrated by the example of water splitting.** Behr, F. (Technische Hochschule Aachen (Germany, F.R.). Fakultaet fuer Maschinenwesen). 7 Jun 1983. 203p. (In German). NTIS (US Sales Only), PC A10/MF A01. File Number DE87752451.

The author discusses the economic, technical, and thermodynamic aspects of hydrogen production from water by means of nuclear process heat and then proceeds to describe membranes used in electrolysis cells and in systems in which thermochemical or hybrid processes take place.

09 OTHER SYNTHETIC AND NATURAL FUELS

0901 Hydrocarbon Fuels

REFER ALSO TO CITATION(S) 42934, 43136, 43152, 43153, 43155

43126 **(AFME—82-169) Soustons experimental platform: biofuels.** (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1984. 10p. (In French). NTIS (US Sales Only), PC A02/MF A01. File Number DE87753124.

The experimental center of Soustons (FRANCE) for the development of the conversion of ligno-cellulosic matter in motor fuel additives is presented. The future conversion systems will use aerobic fermentation, enzymatic hydrolysis, anaerobic fermentation and physico-chemical techniques such as vapour explosion of raw lignocellulosic matters (pretreatment) and distillation for the separation and purification processes.

43127 **(AFME—83-210-2) Veredia group (waste energetic beneficiation and energy savings in food industries) and methane fermentation. Final report.** Albagnac, G.; Maugenet, J. (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1984. 217p. (In French). NTIS (US Sales Only), PC A10/MF A01. File Number DE87753127.

A review of the Veredia group research works is presented; three main topics are reported: energy conversion from agriculture and food industry wastes (methane fermentation, study of the reaction kinetics, models and experimental tests), energy conservation in the food industry (dairy processing heat exchanger tubes soiling and cleaning, study of an agitated film evaporator), and effects on the food process technology of these energy developments.

43128 **(DOE/ER/13624—1) A transient kinetic investigation of Ni-catalyzed methanation: Annual report.** Godbole, G.G.; Goodwin, J.G. Jr. (Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering). May 1987. Contract FG02-86ER13624. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013944.

The most important objective of this research is to gain an insight into the nature of the main surface species involved during methanation and to develop an understanding of factors influencing the rate determining process. With this ultimate goal in mind, studies of the reaction pathways of oxygen (and oxygen containing surface species) have been conducted. From experiments carried out by adding water to the gas phase and switching between isotopes $H_2{}^{16}O$, $H_2{}^{18}O$ and $D_2{}^{16}O$, it was concluded that oxygen, once reacted to form water, does not apparently readsorb. However, hydrogen in the water molecule can be readily exchanged with hydrogen on the surface, perhaps by an Eley-Rideal type of mechanism. By following multiple transients of carbon and oxygen, simultaneously, during ^{12}CO-^{13}CO switch experiments, it was found that the residence time (and hence the size of the precursor adsorbed species reservoir) of water is either equal to or greater than that of methane, depending upon the reaction conditions and the catalyst employed. Future experiments planned include transients by switching between $^{16}O_2$ and $^{18}O_2$ under reaction conditions. These experiments, along with those already carried out, will be able to focus on the long-debated issue in the literature about whether or not the most abundant reaction intermediate (MARI) during methanation is an oxygen containing species. Future experiments will also include studies on a series of Ni and Ru catalysts in order to understand the effect of initial carbon deposition on methanation.

43129 **(DOE/PC/90533—3) Deactivation by carbon of iron catalysts for indirect liquefaction: Quarterly technical progress report for period March 16, 1987 to June 15, 1987.** Bartholomew, C.H. (Brigham Young Univ., Provo, UT (USA)). 10 Aug 1987. Contract FG22-86PC90533. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013748.

Significant progress has been made in the design and construction of a computer-automated reactor system to be used in the kinetic and deactivation studies. A new HP5890 chromatograph was ordered for this system. Kinetic data for CO hydrogenation on unsupported, unpromoted iron were obtained at four different temperatures. Altogether 19 runs were conducted as a function of temperature and time. The activity/selectivity data are consistent with those previously reported for supported, unpromoted iron. 46 refs., 12 figs., 6 tabs.

43130 **(FRNC-TH—2428) Influence of nitrogenous nutrition and light intensity on growth and hydrocarbon production of Botryococcus Braunii.** Brenckmann, F. (Paris-11 Univ., 91 - Orsay (France)). 1984. 150p. (In French). NTIS (US Sales Only), PC A07/MF A01. File Number DE87753130.

The Botryococcus Braunii microalga is characterized by its aliphatic hydrocarbon high content. This study is concerned with the characteristics of cultivation of this alga and the possible improvement of its hydrocarbon production. Two cultivation techniques are examined: batch air lift and chemostat (continuous). The influence of the luminous intensity is analyzed and the nitrate absorption parameters of B. Braunii, its photosynthetic and respiration activity, and its carbon and nitrogen content are compared with those of other algae with respect to hydrocarbon production.

43131 **(PB—87-197547/XAB) Conversion of municipal sludge to oil.** Lee, K.M.; Griffith, P.; Farrell, J.B.; Eralp, A. (Environmental Protection Agency, Cincinnati, OH (USA). Water Engineering Research Lab.). Jun 1987. 35p. (EPA—600/D-87/191). NTIS, PC A03/MF A01.

Thermal conversion of municipal sludge to oil was investigated as a viable alternative for ultimate sludge disposal for generation of energy. The conversion process using water as a solvent was evaluated in a batch mode using primary and secondary municipal sludges. A well defined oil separation procedure was developed in the research. The oil obtained after thermal conversion was dark brown, solid at room temperature and liquid at above 50°C, with an average heat content of 9400 cal/g oil. The increase of oil mass and energy yields as a result of thermal reaction was 73 and 67% in the primary sludge, and 515 and 485% in the secondary sludge, respectively, all with 10.9% volatile solids content. Catalyst addition did not increase the oil mass and energy yields. Data showed that primary sludge produces more oil and energy and less byproduct than secondary sludge in the thermal-conversion process.

43132 **Catalytic hydrotreating of biomass-derived oils.** Baker, E.G.; Elliott, D.C. (Pacific Northwest Lab., Richland, WA 99352). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **32**: No. 2, 257-263(Apr 1987). (CONF-870410—). Contract AC06-76RL01830.

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

Pacific Northwest Laboratory (PNL) is investigating the catalytic upgrading of biomass-derived oils to liquid hydrocarbon fuels. Tests have been conducted in a 1-liter, continuous feed, fixed-bed catalytic reactor at 250-450°C and 2,000 psig. This is envisioned as the second stage in a two-stage process to produce hydrocarbon fuels from biomass. Given that biomass can be converted to a liquid product, widely reported as phenolic, then oxygen removal and molecular weight reduction are necessary to produce usable hydrocarbon fuels. Upgrading biomass derived oils differs from processing petroleum fractions or coal liquids because of the importance of deoxygenation. This topic has received only limited attention in the literature.

43133 **Product analysis from direct liquefaction of several high-moisture biomass feedstocks.** Elliott, D.C.; Sealock, L.J. Jr.; Butner, R.S. (Pacific Northwest Lab., P.O. Box 999, Richland, WA 99352). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **32**: No. 2, 186-194(Apr 1987). (CONF-870410—). Contract AC06-76RL01830.

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

Product analysis in support of the process development research in biomass direct liquefaction began at rudimentary level of determining solvent-soluble portions of the product. Analysis was soon extended to elemental analyses and proximate analyses, such as ash and moisture. Later, spectrometric analyses were performed followed by detailed chemical analyses used in conjunction with chromatographic separation techniques. At all stages of development, the significant differences in composition between the products of flash pyrolysis and high-pressure processing have been evident. While polar solvents are most effective for both products, less polar solvents such as methylene chloride and even benzene and toluene have been used as extractants for high-pressure product oils.

0902 Alcohol Fuels

REFER ALSO TO CITATION(S) 43424

43134 **(SERI/STR—231-3182) Degradation of lignocellulosic biomass and its subsequent utilization for the production of liquid fuels: Subcontract progress report, 1 March 1981-31 August 1981.** Cooney, C.L.; Demain, A.L.; Sinskey, A.J.; Wang, D.I.C. (Massachusetts Inst. of Tech., Cambridge (USA); Solar Energy Research Inst., Golden, CO (USA)). Jul 1987. Contract AC02-83CH10093. 146p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87012267.

This project is a coordinated effort to develop process technology for the degradation of lignocellulosic biomass and its utilization for the production of liquid fuels. Current efforts are based on our prior success in developing a single-step microbiological process for the conversion of lignocellulose to ethanol. This process utilizes a mixed culture of Clostridium thermocellum, a thermophilic cellulolytic anaerobe which degrades cellulose and hemicellulose to fermentable sugars, and C. thermosaccharolyticum, a thermophilic anaerobe which produces high concentrations of ethanol from both hexoses and pentoses. The proposed studies will focus on the use of C. therocellum and its cellulases for enhanced saccharification of lignocellulose and on the direct fermentation of lignocellulose to the liquid fuel, butanol. Efforts on saccharification are directed to facilitate the adoption of existing fermentation ethanol plants for cellulosic substrates and to overcome the rate limiting step of saccharification in the mixed culture. The effort on butanol will extend the concept of direct fermentation to the production of this fuel. 55 figs., 6 tabs.

43135 **(SERI/STR—231-3192) Ethanol production via fungal decomposition and fermentation of biomass: A subcontract report.** Antonopoulos, A.A.; Wene, E.G. (Argonne National Lab., IL (USA); Solar Energy Research Inst., Golden, CO (USA)). Aug 1987. Contract AC02-83CH10093;W-31109-ENG-38. 223p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE87012276.

This report summarizes research efforts and results on ethanol production via Fusarium decomposition and fermentation during 1980 to the present. Reports, meeting papers, and oral presentations derived from this work are included. More than 3500 Fusarium isolated were obtained from natural substrata, and a few mutant strains were developed through uv irradiation of selected wild strains. All were tested for their potential to hydrolyze cellulose using the cellulose-agar text-tube technique. The ability of Fusaria to produce ethanol was tested under a variety of conditions. The ability of Fusaria to ferment xylose was also tested.

0903 Inorganic Hydrogen Compound Fuels

REFER ALSO TO CITATION(S) 43424, 44038

0904 Solid Waste And Wood Fuels

REFER ALSO TO CITATION(S) 43147, 43155, 43982

0905 Liquid Waste Fuels

43136 **(FRT—79-7-0216) Recovery of combustible materials in liquid or viscous wastes.** Lucas, J. (Delegation Generale a la Recherche Scientifique et Technique (DGRST), 75 - Paris (France)). 1984. 62p. (In French). NTIS (US Sales Only), PC A04/MF A01. File Number DE87753155.

A drying device for liquid and viscous waste fluids have been designed in order to transform wastes into fuel. The device is based on mechanical vapour recompression with a membrane-piston compressor avoiding dust problems. The drying process is completed by spraying the concentrated juice on tubular pipes in which flows a high temperature vapor. The dry matter falls by itself or is scraped automatically.

13 HYDRO ENERGY

REFER ALSO TO CITATION(S) 43424

1303 Plant Design And Operation

43137 **(NP—7752962) Two new hydroelectric power plants on the banks of the River Lahn. Documentation.** Schoenefeld, L. (Lahnkraftwerke A.G., Frankfurt am Main (Germany, F.R.)). 1986. 48p. (In German). NTIS (US Sales Only), PC A03. File Number DE87752962.

The Lahnkraftwerke AG (LKW) Limburg, builders of the Dausenau and Nassau hydroelectric power plants are a 100% subsidiary company of the Main-Kraftwerke AG (MKW). The Lahnkraftwerke documentation comprises the following chapters: address on the occasion of the celebration of the initiation of the Nassau hydroelectric power plant, aspects to be considered in the construction of new hydroelectric power plants on the banks of the river Lahn from the point of view of energy policy and the electric power industry, correction and extension of the river Lahn as a navigable water way, expansion of power plants along the banks of the river Lahn, construction and installation of the Dausenau and Nassau hydroelectric power plants (planning, geological analyses, model experiments, turbines, generators, electric equipment), companies participating in the construction and installation of the plants. (HAG).

1306 Environmental Aspects

REFER ALSO TO CITATION(S) 44141, 44204

43138 **(DOE/BP/12659—3) Quantification of Hungry Horse Reservoir water levels needed to maintain or enhance reservoir fisheries: Annual report, 1986.** May, B.; Weaver, T. (Montana Dept. of Fish, Wildlife and Parks, Kalispell (USA)). Aug 1987. Contract AI79-83BP12659. 179p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE87013981.

The Hungry Horse Reservoir study is part of the Northwest Power Planning Council's resident fish and wildlife plan. The plan is responsible for mitigating damages to the fish and wildlife resources caused by hydroelectric development in the Columbia River Basin. The major goal is to quantify seasonal water levels needed to maintain or enhance the reservoir fishery. This report contains a summary of limnological, food habits, fish abundance and fish distribution data collected. Specific study objectives were: (1) estimate the impact of reservoir operation on major game fish species; (2) develop relationships between reservoir drawdown and reservoir habitat use by fish and fish food organisms; (3) quantify the amount of reservoir habitat available at different water level elevations; (4) estimate recruitment of westslope cutthroat trout juveniles from important spawning and nursery areas; (5) determine the abundance, growth, distribution and use of available habitat by major game species in the reservoir; (6) determine the abundance and availability of fish food organisms in the reservoir; and (7) quantify the seasonal use of available food items by major fish species.

1307 Power-conversion Systems

43139 **(EPRI-AP—4713) Comparison of acoustic and conventional flow measurement techniques at the Raccoon Mountain Pumped-Storage Plant: Final report.** March, P.A.; Missimer, J.R.; Voss, A.; Pearson, H.S. (Tennessee Valley Authority, Norris (USA). Engineering Lab.; Electric Power Research Inst., Palo Alto, CA (USA)). Aug 1987. 91p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920538.

The Electric Power Research Institute (EPRI) initiated a research project to evaluate the technical and economic feasibility of using the acoustic method of flow measurement in hydroelectric power plant efficiency tests. As a portion of this program, the Tennessee Valley Authority's (TVA) Raccoon Mountain Pumped-Storage Plant was chosen as one of the sites to be tested. The primary objective of the TVA test was to compare the measurements of the Ocean Research Engineering (ORE), acoustic flowmeter installed on Unit 1 to the Volumetric and Winter-Kennedy Techniques for flow measurement. The Winter-Kennedy Technique is the standard flow measurement technique used in the plant. The Volumetric Technique consisted of accurate measurement of the upper reservoir volume over specified time increments. For calibration, the upper reservoir was initially drained and as it was being filled, aerial photographs were taken to obtain contour lines which were correlated with simultaneous stage measurements. The photographs were used to compute the differential volume of the reservoir associated with a change in stage. Six performance tests were conducted on Unit 1. During the tests no other units were operated. Five tests were conducted in the generating mode and one test was conducted in the pumping mode. The uncertainty in the measurements using the Volumetric Technique is of the order of 0.5 percent for changes of stage elevation in excess of two feet. The flowrate measured by the ORE acoustic flowmeter was consistently of the order of 1.5 percent lower than the flowrate determined from the Volumetric Technique in both the generating and pumping modes. 3 refs., 32 figs., 14 tabs.

14 SOLAR ENERGY

1403 Economics

REFER ALSO TO CITATION(S) 43145

1405 Solar Energy Conversion

REFER ALSO TO CITATION(S) 43126, 43127, 43130, 43132, 43133, 43134, 43135, 43170, 43387, 43432, 43433, 43641, 43681, 43681, 43694

43140 **(AD-A—180757/7/XAB) Transient photovoltaic effect in InAs-GaSb superlattices.** Voisin, P.; Brum, J.A.; Voos, M.; Chang, L.L.; Esaki, L. (International Business Machines Corp., Yorktown Heights, NY (USA). Thomas J. Watson Research Center). 1986. 13p. NTIS, PC A02/MF A01.

Pub. in Surface Science, Vol. 174, 255-260(1986).

The authors describe theoretically a new, transient, photovoltaic effect that occurs in superlattices, presenting spatial separation of the electron and hole wave functions together with a lack of global-reflection symmetry. The luminescence of an indium arsenide-gallium antimonide semiconductor superlattice under pulsed excitation shows an increase of the band gap with the density of injected carriers, which are related to this photovoltaic effect.

43141 **(AFME—82-147) Study of the production of beta Glucosidase and xylanases for using lignocellulosic wastes in acetone-butanol fermentation.** Deschamps, F.; Huet, M.C. (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1984. 59p. (In French). NTIS (US Sales Only), PC A04/MF A01. File Number DE87753126.

The addition of cellobiase and xylanase to the enzymatic cocktail produced by Trichoderma for the saccharification of corn straw is studied. The influence of this addition on the straw hydrolysis rate and on the sugar yield rate is examined as a function of the substrate and culture medium composition, and as a function of the operating conditions: temperature, aeration, pH, agitation, etc.

43142 **(AFME—83-210-1) Cellulolysis-alcohol - final report.** Dupuy, P. (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1984. 67p. (In French). NTIS (US Sales Only), PC A04/MF A01. File Number DE87753125.

This report is concerned with the research-development on different aspects of the fermentation of ligno-cellulosic products. The main topics are: lignin degradation with white mould fungi, pretreatment of wood before cellulolysis (destructuration, extrusion, explosion - the most efficient), study of some cellulolytic florae and separation of several phylum, study of the cellulolytic activity of the Gram - bacteriae (Erwinia) and of its possible transfer to Zymomonas, direct fermentation of cellulose with clostridium thermocellum for the production of alcohol, and fermentation of pre-hydrolyzed cellulose.

43143 **(AFME—83-210-3) INRA-AFME frameword agreement. Convention 1983. Synthesis of the final report.** (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1984. 10p. (In French). NTIS (US Sales Only), PC A02/MF A01. File Number DE87753128.

A synthetic review of a multipurpose study is proposed. The study is composed of several topics: production of biomass (forest and agriculture), transformation of the biomass through a biological way (alcohol cellulolysis, methane fermentation), and energy management: rational utilization of the energy and economical research and analysis. For each topic, some case studies are given.

43144 **(AFME—83-210-4) Agricultural biomass. Final report.** (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1984. 160p. (In French). NTIS (US Sales Only), PC A08/MF A01. File Number DE87753129.

A review of different research works on the agricultural and aquatic biomass is presented. Four main topics are reported: evaluation of the agronomic value of the energetic wastes from biomass

conversion and study of the effect of the transfer of these residues on the soil quality, modelisation of the dry matter production (mainly ligno cellulosic products) and soil-climate data processing for a geographic district, experimental study of the production yield of Genesta and reed as a function of the cultural treatment, experimental study of the Jerusalem artichoke: comparative test of various clone (yield rate) and folliage surface evaluation.

43145 **(CONF-870364—3) Cost goals for biofuels technologies.** Gaines, L.L.; Flaim, S.J. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011535.

From Energy from biomass and wastes; Orlando, FL, USA (16 Mar 1987).

Federally funded energy research seeks to demonstrate that alternative fuels can be produced and then to induce private sector involvement by showing that they can be produced profitably. Prices for fossil fuels may be used as cost goals for biofuels to determine when profitability may be achieved. Achieving equality with fossil fuel prices drives out the highest-cost sources of supply and enables initial market penetration; as costs decrease, biofuels can potentially gain a greater market share. However, achieving competitive costs is not a sufficient condition for success unless prices of conventional substitutes are expected to rise. Cost goals are used for research planning purposes, as a common denominator to allow comparisons among many biofuels options. Application of standard investment criteria to biofuels R & D would require that benefits from their use pay back research costs. These benefits must be discounted because they are realized in the future. Furthermore, realization of future savings is uncertain, so risks must be accounted for. Research may be justified if the expected value of the discounted benefits is greater than the discounted cost of the research. Cost goals satisfying this condition might be substantially lower than projected fuel prices. This paper examines recent fossil fuel price projections and discusses the challenges biofuels research faces just to produce competitive products. In light of the difficult goals, researchers should adopt a strategy targeting major technological breakthroughs rather than incremental improvements. Production of ethanol from wood is used as an example of this strategy. 35 refs., 8 figs., 7 tabs.

43146 **(DOE/BP/17608—T1) Estimators and characteristics of logging residue in California: Final report.** Howard, J.O.; Bulgrin, J.K. (Forest Service, Portland, OR (USA). Pacific Northwest Forest and Range Experiment Station). 19 Apr 1985. Contract AI79-84BP17608. 116p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87013424.

This study, designed to meet the needs of site-specific analysis of logging residue throughout the State of California, has two primary objectives. First was to develop analytical tools for estimating the volume of logging residue for any uniquely defined supply zone in California. Volume estimators developed in this study relate residue volume to both timber harvest volume and acreage. Second was to describe and classify residue by characteristics that affect utilization. Residue materials were classified as to gross and net volume of logging residue by diameter and length, for live, and dead and cull; to number of pieces of residue per acre, by diameter and length; to volume of residue by percent sound (chippability), in cubic feet per acre; to accessibility of residue on cutover areas, by slope and distance to road; and to volume by softwoods and hardwoods. Residue ratios and characteristics data are displayed for eight sample strata in California, based on geographic area, owner class - harvest method, and forest type. Within geographical areas owner class - harvest method strata were selected on the basis of expected differences in residue volume, availability of data, and land management objectives. A separate stratum was selected for the Ponderosa pine forest type in eastern California based on expected differences in residue volume and characteristics. Study results are based on measurements of logging residue on 220 cutover areas allocated across the eight strata. 12 refs., 8 figs., 47 tabs.

43147 **(DOE/BP/35474—T1) Small tree harvest system recovering residue for energy.** Brown, S.L.; Bergvall, J.A. (Washington State Dept. of Natural Resources, Olympia (USA)). 1986. Contract FG79-82BP35474. 46p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013426.

This study describes the development and testing of a portable small tree harvester that maximizes fiber yield; is compatible with various operator setup modes, tree species and terrain; processes trees into merchantable logs, chip logs and fuel wood on the landing site in one operation; and is controlled by one operator.

43148 **(DOE/NBM—7013595) Construction and characterization of amorphous-silicon test structures.** Koppel, L.N.; Milgram, A.A. (Advanced Research and Applications Corp., Sunnyvale, CA (USA)). Aug 1987. Contract W-7405-ENG-36. 29p. (ARACOR/TR—524-01). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013595.

The central goal of the project was to qualify amorphous silicon, a newly developed semiconductor material, as the basis for economical large-area photoconductive detectors of penetrating radiation. The thrust of the project was to establish the feasibility of constructing photoconductive amorphous-silicon devices whose electronic properties supported the radiation detection application. This issue of feasibility was successfully resolved by construction and experimental characterization of amorphous-silicon test pieces representative of the existing state-of-the-art. The focus of this work was the measurement of material electronic properties known to affect the performance of solid-state radiation detectors, and the investigation of candidate junction-device architectures. The construction and experimental evaluation of prototype radiation detectors based on amorphous silicon was beyond the scope of the current effort, and will form the core of work to be accomplished within a Phase II continuation of the project.

43149 **(DOE/OR/21390—14) Great Lakes Regional Biomass Energy Program: Quarterly report, December 1, 1986-February 28, 1987.** Bancroft, D. (Council of Great Lakes Governors, Inc., Madison, WI (USA)). Jul 1987. Contract FG05-83OR21390. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013897.

This is the second quarterly report of the fourth year of operation of the Great Lakes Regional Biomass Energy Program. The program was initiated in 1983 with a grant to the Council of Great Lakes Governors from the Biofuels and Municipal Waste Technology Division of the US Department of Energy. Stressing near-term biomass feedstock production techniques and conversion processes, the objective of the program is to increase the use of biomass energy by the public and private sectors in the seven state Great Lakes region. States that are in the Great Lakes region include: Illinois, Indiana, Iowa, Michigan, Minnesota, Ohio and Wisconsin. The Great Lakes Regional Biomass Energy Program is divided into three separate operational programs. The first is the State Grant Program, which provides resources to the seven state energy offices in the region to increase their capabilities in biomass energy. State-specific activities and the interagency programs are emphasized in the State Grant Program. The second, the Subcontractor Program, involves the letting of subcontracts to private organizations to address regional biomass issues and needs. The third is the In-House Technology Transfer Program in which Council staff develop biomass energy publications and reports. During this quarter the large technology transfer effort that reached its peak last quarter began to fade and the region started gearing up for the regional policy analysis requested by the governors. A total of six workshops were held. The University of Wisconsin-Extension conducted four waste to energy incineration workshops and the Meridian Corporation performed two short rotation workshops. Two publications on crop residue combustion were released, namely: (1) Decision-Makers' Guide to Crop Residue Energy Systems; and (2) Combustion of Crop Residues for Energy - Case Studies from the Great Lakes.

43150 **(DOE/OR/21390—15) Great Lakes Regional Biomass Energy Program: Quarterly report, March 1, 1987-May 31, 1987.** Bancroft, D. (Council of Great Lakes Governors, Inc., Madison, WI (USA)). Jul 1987. Contract FG05-83OR21390. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013896.

This is the third quarterly report of the fourth year of operation of the Great Lakes Regional Biomass Energy Program. The program was initiated in 1983 with a grant to the Council of Great

Lakes Governors from the Biofuels and Municipal Waste Technology Division of the US Department of Energy. Stressing near-term biomass feedstock production techniques and conversion processes, the objective of the program is to increase the use of biomass energy by the public and private sectors in the seven state Great Lakes region. States that are in the Great Lakes region include: Illinois, Indiana, Iowa, Michigan, Minnesota, Ohio and Wisconsin. The Great Lakes Regional Biomass Energy Program is divided into three separate operational programs. The first is the State Grant Program, which provides resources to the seven state energy offices in the region to increase their capabilities in biomass energy. State-specific activities and interagency programs are emphasized in the State Grant Program. The second, the Subcontractor Program, involves the letting of subcontracts to private organizations to address regional biomass issues and needs. The third is the In-House Technology Transfer Program in which Council staff develop biomass energy publications and reports. During this quarter the final workshops of the large technology transfer drive undertaken last year were concluded. Subcontractors completed workshops for four topics including: wood energy design; wood energy conversion; waste-to-energy incineration; and short rotation forestry. As part of the regional biomass policy analysis project, private sector focus groups were held in Ohio and Indiana by the Meridian Corporation. The Illinois Department of Energy and Natural Resources held the Alternative Energy in the Midwest Conference at which both the Project Director and Program Associate made presentations.

43151 **(EUR—9929) Dry etching process in solar cell fabrication.** Loubly, P.; Aubril, P. (Commission of the European Communities, Luxembourg). 1985. 101p. (In French). NTIS (US Sales Only), PC A06/MF A01. File Number DE87753135.

The aim of the present work was to develop a cost effective process for solar cell manufacturing. Dry etching and screen printing techniques have been investigated. Plasma etching was used for surface sawing damage removal, edge leakage current reduction (ring edging) and selective oxide etching. Diffusion from screen printed doping layers has been employed in the preparation of single step and two step structures. The preliminary application of the above techniques to semicrystalline material has been carried out. An economical analysis showed that some of the investigated processes are ready to be used by solar cell manufacturers.

43152 **(EUR—9973) Preparatory study for a comprehensive project to exploit the Algae in the Lagoon of Venice to produce energy and improve the environment. Final report.** Croatto, U.; Cescon, P.; Linneborn, J.; Strehler, A. (Commission of the European Communities, Luxembourg). 1985. 74p. NTIS (US Sales Only), PC A04. File Number DE87753166.

The investigations concern mapping, collection, storage, conversion and industrial processing of algae: data of Italian lagoons and coastal marshes were collected, technical possibilities for algae collection studied, the storage of algae investigated: cost of varieties of silos, drying of algae using solar energy. Concerning the conversion of algae, studies on anaerobic digestion of algae biomass have been carried out: pretreatment tests and charge preparation systems described, different digester types evaluated, the toxicity of algae determined, moreover studies made of anaerobic mesophilic fermentation of macro algae biomass from the Venice lagoon, and of series production of biogas plants for digestion of algae; furthermore many possibilities of algae-utilization described: biological conversion, thermal conversion after drying by solar energy, with in the case of conversion to energy carriers via pyrolysis charcoal, pyrolysis oil and gas being obtainable, and thermal gasification with liquid fuel for cars etc. via methanol generation followed by Mobil process for the production of synthetic gasoil. As to series production, it is found that plants on an industrial scale for biogas and methanol production cannot be constructed yet.

43153 **(EUR—9975) Study and development of tubular photoreactors for the controlled production of "methanisable" photosynthetic cellular biomass and of specific exocellular biomass.** Gudin, C.; Bernard, A.; Chaumont, D. (Commission of the European Communities, Luxembourg). 1985. 147p. (In French). NTIS (US Sales Only), PC A07/MF A01. File Number DE87753172.

This report concludes the CEE contract number ESE-R-073-F-(SD) concerning the development of new technologies for controlled production of photosynthetic biomass. The technology chosen by the authors of confined tubular reactors for the culture itself has been proved successful up to a 10 m/sup 2/ level. It has been used for several different biotechnological processes using microalgae covering cellular biomass production as well as exocellular chemicals production such as polysaccharides or hydrocarbons. The structure of the reactor allows sophisticated instrumentation and control over the biotechnological events. It can be run continuously for several months. Good control of the process leads to better understanding of basic aspects of microalgae metabolism: photoperiodic rythms, carbon dioxide fixation, photoconversion yields increase. Downstream processing has been studied comparing reliable, well known methods (centrifugation, filtration) with more recent advances in that field (micro, ultra, diafiltration). Thermal regulation has received a lot of attention, considering the structure of the reactors used (thin layer). Estimates for the economic viability of such a biotechnology are proposed which show the bottlenecks for the development of solar biotechnology. Finally, as was originally planned, a 100 m/sup 2/ unit has been dimensioned and is ready for construction in 1984.

43154 **(EUR—10002) Optimization of polycrystalline silicon solar cells produced by ion implantation and pulsed laser annealing. Final report.** Sinke, W.; Van Sark, W.; Doorn, S.; Saris, F.W. (Commission of the European Communities, Luxembourg). 1985. 44p. NTIS (US Sales Only), PC A03. File Number DE87753143.

Polycrystalline silicon solar cells have been made by shallow, mass-analyzed ion-implantation followed by Q-switched ruby-laser annealing. The influence of surface finish and of thermal treatments during and after pulsed-laser annealing on cell performance has been studied. Screenprinted contacts have beem applied on these cells and the influence of implanted dose as well as laser-annealing conditions on contact resistance has been investigated. It was found that smooth, acid-etched surfaces give better results than texturized sodium-etched surfaces. With pulsed-laser annealing on a heated (350/sup 0/C) substrate it is easier to achieve good cell performance than with p.l.a. at room temperature. A thermal anneal at 450/sup 0/C after p.l.a. improves V/sub oc/ considerably. The problem of series resistance, which is encountered when screen-printed contacts are applied to ion-implanted junctions can be eliminated by increasing the implanted dose. By doing so, we have obtained over 10% AM 1.5 efficiency on 90m/sup 2/ polysilicon cells.

43155 **(EUR—10004) Catalytic liquefaction of wood material.** Burton, A.; De Zutter, D.; Poncelet, G.; Grange, P.; Delmon, B. (Commission of the European Communities, Luxembourg). 1986. 132p. (In French and English). NTIS (US Sales Only), PC A07. File Number DE87753170.

The purpose of this work is to define the experimental conditions for catalytic hydroliquefaction of woody material. At this stage of the study a new analytical method for the characterisation of the products coming from the liquefaction has been developed and is described. This method permits separation and evaluation of five classes of products we define as "light-oil", asphaltenic compounds, residues, phenolic compounds and neutral compounds. A second aspect of the project deals with a systematic investigation of the influence of experimental parameters such as temperature, amounts of catalyst, H/sub 2/S pressure on the catalytic liquefaction of wood, using to date the same type of catalyst and solvent. Later we hope to test the efficiency of several types of catalysts for the liquefaction.

43156 (EUR—10323) Pyrolysis and gasification of wood under pressure. Chrysostome, G.; Lemasle, J.M. (Commission of the European Communities, Luxembourg). 1985. 28p. (In French). NTIS (US Sales Only), PC A03. File Number DE87753167.

The realization of the wood gasification pilot unit of Clamecy, which will be operated under pressure needs that the physico-chemical behaviour of wood during pyrolysis and gasification is well known. A thermal-balance (allowing to evaluate the kinetics of pyrolysis/gasification reactions), has been experimented under pyrolysis conditions and four determining parameters of the fluid bed reactor have been investigated: the fluidizing gas velocity, temperature, wood-chips size, pressure. Results are presented, showing that the reaction of pyrolysis of wood chips (di > 5 mm) is mainly limited by the internal heat transfer in the biomass particle: this explains why the influence of parameters such as the fluidizing gas velocity and pressure is only significant in a limited range and that we rapidly reach a limit in the pyrolysis rate.

43157 (FRNC-TH—2169) Contribution to the study of the amorphous silicon evaporated in ultra-vacuum and post hydrogenated: hydrogen diffusion and electronic properties. Flachet, J.C. (Paris-7 Univ., 75 (France)). 1983. 96p. (In French). NTIS (US Sales Only), PC A05/MF A01. File Number DE87753161.

Properties of amorphous silicon and hydrogenated amorphous silicon are presented. Techniques for the fabrication of thin layers of hydrogenated amorphous silicon and experimental methods are described. Experimental results on hydrogen diffusion and material characterization are given. 123 refs.

43158 (N—87-22098) Radiation and temperature effects in gallium aresenide, indium phosphide and silicon solar cells. Weinberg, I.; Swartz, C.K.; Hart, R.E. Jr.; Statler, R.L. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1987. 14p. (CONF-870528—18; NASA-TM—89870; E—3546; NAS—1.15:89870). NTIS, PC A02/MF A01.

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

The effects of radiation on performance are determined for both n(+)p and p(+)n GaAs and InP cells and for silicon n(+)p cells. It is found that the radiation resistance of InP is greater than that of both GaAs and Si under 1 MeV electron irradiation. For silicon, the observed decreased radiation resistance with decreased resistivity is attributed to the presence of a radiation induced boron-oxygen defect. Comparison of radiation damage in both p(+)n and n(+)p GaAs cells yields a decreased radiation resistance for the n(+)p cell attributable to increased series resistance, decreased shunt resistance, and relatively greater losses in the cell's p-region. For InP, the n(+)p configuration is found to have greater radiation resistance than the p(+)n cell. The increased loss in this latter cell is attributed to losses in the cell's emitter region. Temperature dependency results are interpreted using a theoretical relation for dVoc/cT which predicts that increased Voc should results in decreased numerical values for dPm/dT. The predicted correlation is observed for GaAs but not for InP a result which is attributed to variations in cell processing.

43159 (N—87-22301) Optimization methods and silicon solar cell numerical models. Final report. Girardini, K.; Jacobsen, S.E. (California Univ., Los Angeles (USA)). Oct 1986. 319p. (NASA-CR—180917; JPL—9950-1254; NAS—1.26:180917). NTIS, PC A14/MF A01.

An optimization algorithm for use with numerical silicon solar cell models was developed. By coupling an optimization algorithm with a solar cell model, it is possible to simultaneously vary design variables such as impurity concentrations, front junction depth, back junction depth, and cell thickness to maximize the predicted cell efficiency. An optimization algorithm was developed and interfaced with the Solar Cell Analysis Program in 1 Dimension (SCAP1D). SCAP1D uses finite difference methods to solve the differential equations which, along with several relations from the physics of semiconductors, describe mathematically the performance of a solar cell. A major obstacle is that the numerical methods used in SCAP1D require a significant amount of computer time, and during an optimization the model is called iteratively until the design variables converge to the values associated with the maximum efficiency. This problem was alleviated by designing an optimization code specifically for use with numerically intensive simulations, to reduce the number of times the efficiency has to be calculated to achieve convergence to the optimal solution.

43160 (N—87-22702, pp vp) Solar array flight dynamic experiment. Schock, R.W. Apr 1987. NTIS, PC A99/MF E03. (CONF-8604346—Pt.1; NASA-CP—2467-PT-1; M—554-PT-1; NAS—1.55:2467-PT-1).

From Structural dynamics and control interaction of flexible structures; Huntsville, AL, USA (22 Apr 1986).

The purpose of the Solar Array Flight Dynamic Experiment (SAFDE) is to demonstrate the feasibility of on-orbit measurement and ground processing of large space structures' dynamic characteristics. Test definition or verification provides the dynamic characteristic accuracy required for control systems use. An illumination/measurement system was developed to fly on space shuttle flight STS-41D. The system was designed to dynamically evaluate a large solar array called the Solar Array Flight Experiment (SAFE) that had been scheduled for this flight. The SAFDE system consisted of a set of laser diode illuminators, retroreflective targets, an intelligent star tracker receiver and the associated equipment to power, condition, and record the results. In six tests on STS-41D, data was successfully acquired from 18 retroreflector targets and ground processed, post flight, to define the solar array's dynamic characteristic. The flight experiment proved the viability of on-orbit test definition of large space structures dynamic characteristics. Future large space structures controllability should be greatly enhanced by this capability.

43161 (N—87-22729, pp vp) Slewing control experiment for a flexible panel. Juang, J.N. Apr 1987. NTIS, PC A99/MF E03. (CONF-8604346—Pt.2; NASA-CP—2467-PT-2; M—554-PT-2; NAS—1.55:2467-PT-2).

From Structural dynamics and control interaction of flexible structures; Huntsville, AL, USA (22 Apr 1986).

Technology areas are identified in which better analytical and/or experimental methods are needed to adequately and accurately control the dynamic responses of multibody space platforms such as the space station. A generic space station solar panel is used to experimentally evaluate current control technologies. Active suppression of solar panel vibrations induced by large angle maneuvers is studied with a torque actuator at the root of the solar panel. These active suppression tests will identify the hardware requirements and adequacy of various controller designs.

43162 (N—87-22729, pp vp) New approach for vibration control in large space structures. Kumar, K.; Cochran, J.E. Jr. Apr 1987. NTIS, PC A99/MF E03. (CONF-8604346—Pt.2; NASA-CP—2467-PT-2; M—554-PT-2; NAS—1.55:2467-PT-2).

From Structural dynamics and control interaction of flexible structures; Huntsville, AL, USA (22 Apr 1986).

An approach for augmenting vibration damping characteristics in space structures with large panels is presented. It is based on generation of bending moments rather than forces. The moments are generated using bimetallic strips, suitably mounted at selected stations on both sides of the large panels, under the influence of differential solar heating, giving rise to thermal gradients and stresses. The collocated angular velocity sensors are utilized in conjunction with mini-servos to regulate the control moments by flipping the bimetallic strips. A simple computation of the rate of dissipation of vibrational energy is undertaken to assess the effectiveness of the proposed approach.

43163 (SAND—87-1750) Joint Crystalline Cell Research and Concentrating Collector projects review. Chiang, C.J. (ed.). (Sandia National Labs., Albuquerque, NM (USA)). Aug 1987. Contract AC04-76DP00789. 296p. NTIS, PC A13/MF A01; 1; GPO Dep. File Number DE87013845.

This report is the proceedings for an annual meeting hosted by the Cell Research and the Concentrator Projects at Sandia National Laboratories and sponsored by the Department of Energy. The meeting was held in Albuquerque, NM, on August 25-27, 1987.

The objectives of the meeting were to provide an overview of the plans, activities, and goals of the Department of Energy's Photovoltaic Program, to assess the status of photovoltaic cell and concentrating collector research, and to promote exchange of technical information. The Cell Research Project, including III-V cell research, silicon one-sun cell research, and silicon concentrator cell research, was reviewed. The Concentrator Project, including concentrator module and array research, materials and components for concentrators, and reliability research, was reviewed. This report contains abstracts and summaries of presentations made at the meeting and status reports for current research contracts.

43164 **(SAND—87-7112) High-efficiency silicon solar cells: Numerical modeling, transient measurements, efficiency goals, and v-shaped grooves.** Basore, P.A. (Iowa State Univ. of Science and Technology, Ames (USA). Microelectronics Research Center). Jul 1987. Contract AC04-76DP00789. 117p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87012842.

This is the final report summarizing concentrator solar cell research activity at Iowa State University under contract to Sandia National Laboratories from March 1985 to September 1986. A new one-dimensional semiconductor device analysis program for personal computers, PC-1D, is presented with emphasis on its application to modeling solar cells. Two applications of this program are described: (1) the validation of a new fast-transient technique for determining the relative importance of recombination in the emitter and base regions of planar silicon solar cells, and (2) the estimation of practical efficiency goals for production solar cells both for concentrators and one-sun applications. A laboratory investigation into etching v-shaped grooves in (100)-oriented silicon is also described.

43165 **(UCRL—96914) Leaf-area estimation of two large-stature riparian species.** Palassou, R.J.; Surano, K.A.; Novo, M.G. (Lawrence Livermore National Lab., CA (USA)). Apr 1987. Contract W-7405-ENG-48. 12p. (CONF-8705170—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87012904.

From Annual PG and E riparian vegetation conference; San Ramon, CA, USA (11 May 1987).

Total canopy leaf area is often a necessary input for modeling energy balance, water use, growth and survivability of riparian habitats. Unfortunately, canopy leaf area is very difficult to measure directly. However, allometric relationships exist for many species and allow estimation of canopy leaf area from easily field-measurable morphological parameters. This study determined preliminary allometric relationships between branch measurements and leaf area for two riparian species, white alder (Alnus rhombifolia) and sandbar willow (Salix hindsiana). Three individuals of each species, growing along the North Fork of the Kings River in California, were dissected in the field. Detailed morphological measurements of each branch were made and actual leaf area was determined using specific leaf-area techniques. Data were analyzed by linear regression methods. For alder, leaf area of main branches can be determined by the following equation: LEAF AREA (cm^2) = 1300 x (branch diameter)^2. For willow, the leaf area of a branch can be estimated by the following equation: LEAF AREA (cm^2) = 7.3 x (branch diameter x branch length). Total leaf area for any individual can then be estimated by summing the leaf area of individual branches. Total canopy leaf area can be estimated by summing the total leaf areas of all individuals in a stand. 8 refs., 3 figs., 2 tabs.

43166 **Electrochromic effects of charge separation in bacterial photosynthesis: theoretical models.** Hanson, L.K.; Fajer, J.; Thompson, M.A.; Zerner, M.C. (Brookhaven National Lab., Upton, NY). *Journal of the American Chemical Society;* **109**: No. 15, 4728-4730(22 Jul 1987). Contract AC02-76CH00016.

The primary charge separation in photosynthetic bacteria generates a dimeric bacteriochlorophyll (BChl) cation and a bacteriopheophytin (BPheo) anion which lie within close proximity of each other (~ 10 A). The two radicals also lie within van der Waals contact on opposite sides of a lone BChl bridging molecule. Spectral changes in the red (Q/sub y/) band of the bridge BChls have been observed on picosecond time scales following excitation of the reaction center (RC) and have been variously attributed to the formation of a BChl anion, to a charge-transfer state, or to electrochromic effects. They present calculations here which suggest that electrochromic effects caused by the photogenerated cation and/or anion can rationalize the optical changes observed in the flash photolyses as well as in trapping experiments.

43167 **An overview of biomass thermochemical liquefaction research sponsored by the U.S. Department of Energy.** Stevens, D.J. (Pacific Northwest Lab., P.O. Box 999, Richland, WA 99352). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **32**: No. 2, 223-228(Apr 1987). (CONF-870410—). Contract AC06-76RL01830.

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

Biomass represents an important energy resource in the United States both at present and as a potential energy contributor for the future. In 1981, for example, it is estimated that biomass contributed about 3.5% of the nations' energy supply, approximately equivalent with nuclear energy which contributed 3.8% in that year. With proper resource management and the development of efficient conversion processes, the Office of Technology Assessment has estimated the potential contribution of biomass to the United States energy supply could range as high as 17 quadrillon Btu per year - almost 20% of current United States energy consumption. Similarly, the Energy Research Advisory Board (ERAB) has estimated that biomass could potentially supply the nation with about 10 quadrillion Btu by the year 2000.

43168 **Excimer laser processing of semiconductor devices: High-efficiency solar cells.** Wood, R.F. (Solid State Div., Oak Ridge National Lab., Oak Ridge, TN 37831). pp 63-72 of Excimer lasers and optics. Luk, T.S. Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1987). (CONF-8609127—). Contract AC05-84OR21400.

From SPIE symposium on optics and optoelectronics; Cambridge, MA, USA (14 Sep 1986).

More recently, results which demonstrate that ultraviolet excimer lasers offer many desirable characteristics for the laser processing of materials, have been reported in the literature. Solar cells are relatively simple semiconductor devices that are of considerable interest in their own right and provide a useful testing ground for the application of laser techniques to semi-conductor processing. In this paper, some important aspects of pulsed laser processing of semiconductors are reviewed, the advantages of excimer lasers for such work are assessed, the present status of laser processing of high-efficiency solar cells is discussed, and finally the possible future directions of this type of work are briefly mentioned.

1406 Photovoltaic Power Systems

43169 **(EUR—9825) Test and demonstration of concentrating photovoltaic generators SOPHOCLE under Mediterranean climatic conditions.** Berry, J.P.; Ganibal, C.; Vialaret, G.; Dupas, A.; Esteve, D.; Laurent, B. (Commission of the European Communities, Luxembourg). 1985. 90p. (In French and English). NTIS (US Sales Only), PC A05/MF A01. File Number DE87753145.

The SOPHOCLE program (Solar Photovoltaic with Limited Concentration of Energy) has for its purpose the development and the experimentation of a family of photovoltaic generators using concentration of Solar rays (C=45). These generators make use of an altazimut mounting with two axis tracking. The conception of the system is modular with Silicon Solars Cells and Concentrating Fresnel lenses integrated six by six in passively cooled modules. After an international program on tests of reliability with low power SOPHOCLE systems, the L.A.A.S. has undertaken an experiment on 500 W/sub p/-generator provided with a DC - motor-pump in parallel with a similar experience at the University of Athens. The aim of this experience, supported by EEC, is in the one hand to analyse the individual behaviour of the modules, concerning watertightness, insulation and disparity of electric characteristics on the other hand to evaluate the energy production line generator-converter - motor-pump.

43170 **(EUR—10219) Reference base for the application and development of standard performance and qualification methods for photovoltaic modules.** Krebs, K.; Rossi-Gianoli, E. (Commission of the European Communities, Ispra (Italy). Joint Research Centre; Commission of the European Communities, Luxembourg). 1985. 72p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87753134.

The performance and qualification test results for a large number of photovoltaic modules covering different design concepts are presented: these tests were executed during the last two years using the ESTI facilities of the JRC. The results reflect the status of the pv technology and demonstrate which kind of defects may be revealed if one applies the EUR test procedures. We have tried to sum up our informations in the form of performance and defect profiles for each of the module types which we investigated. A comparison of these profiles allows to identify in some quantitative way what one could call a good quality state-of-the-art module. It also serves to define the minimum requirements a module has to fulfil if it should be used in pv plants funded by the Commission. The results indicate which problems or failures might occur; they serve also as a means to define a reference frame which allows to measure progress in this field; and they are finally considered essential for studying the correlation between laboratoy test methods and long term in-field behaviour.

43171 **(N—87-22001) Space station electric power system requirements and design.** Teren, F. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1987. 15p. (CONF-870804—22; NASA-TM—89889; E—3577; NAS—1.15:89889; AIAA—87-9003). NTIS, PC A02/MF A01.

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

An overview of the conceptual definition and design of the space station Electric Power System (EPS) is given. Responsibilities for the design and development of the EPS are defined. The EPS requirements are listed and discussed, including average and peak power requirements, contingency requirements, and fault tolerance. The most significant Phase B trade study results are summarized, and the design selections and rationale are given. Finally, the power management and distribution system architecture is presented.

43172 **(N—87-23020) High temperature solid oxide regenerative fuel cell for solar photovoltaic energy storage.** Bents, D.J. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1987. 19p. (NASA-TM—89872; E—3549; NAS—1.15:89872; AIAA—87-9203; CONF-870804—32). NTIS, PC A02/MF A01.

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

A hydrogen-oxygen regenerative fuel cell (RFC) energy storage system based on high temperature solid oxide fuel cell (SOFC) technology is described. The reactants are stored as gases in lightweight insulated pressure vessels. The product water is stored as a liquid in saturated equilibrium with the fuel gas. The system functions as a secondary battery and is applicable to dark-side energy storage for solar photovoltaics.

43173 **(N—87-23028) Performance characteristics of a combination solar photovoltaic heat engine energy converter.** Chubb, D.L. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1987. 14p. (NASA-TM—89908; E—3591; NAS—1.15:89908; AIAA—87-9035; CONF-870804—33). NTIS, PC A02/MF A01.

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

A combination solar photovoltaic heat engine converter is proposed. Such a system is suitable for either terrestrial or space power applications. The combination system has a higher efficiency than either the photovoltaic array or the heat engine alone can attain. Advantages in concentrator and radiator area and receiver mass of the photovoltaic heat engine system over a heat-engine-only system are estimated. A mass and area comparison between the proposed space station organic Rankine power system and a combination PV-heat engine system is made. The critical problem for the proposed converter is the necessity for high temperature photovoltaic array operation. Estimates of the required photovoltaic temperature are presented.

43174 **(N—87-23030) Design, development and deployment of public service photovoltaic power/load systems for the Gabonese Republic. Final report.** Kaszeta, W.J. (Solavolt International, Phoenix, AR (USA)). Apr 1987. 235p. (NASA-CR—179603; NAS—1.26:179603). NTIS, PC A11/MF A01.

Five different types of public service photovoltaic power/load systems installed in the Gabonese Republic are discussed. The village settings, the systems, performance results and some problems encountered are described. Most of the systems performed well, but some of the systems had problems due to failure of components or installation errors. The project was reasonably successful in collecting and reporting data for system performance evaluation that will be useful for guiding officials and system designers involved in village power applications in developing countries.

43175 **(PNL—6243) Photovoltaic industry progress from 1980 through 1986.** Watts, R.L.; Smith, S.A. (Pacific Northwest Lab., Richland, WA (USA)). Jun 1987. Contract AC06-76RL01830. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010841.

The objective of this report is to describe PV industry developments through 1986. Information is presented on a regional basis (United States, Europe, Japan, other) to avoid disclosing company confidential data. Information was gleaned from several sources, including a review of technical literature and direct contacts with many PV manufacturers. Before the regional totals were published, all numbers were compared with those from other sources published in the United States and those supplied by Japanese industry through their solar energy organization.

1407 Solar Thermal Power Systems

REFER ALSO TO CITATION(S) 43171, 43173

43176 **(LBL—22743) Solar radiant heating of gas-particle mixtures: Final report (FY 1985 and FY 1986).** Hunt, A.J.; Ayer, J.; Hull, P.; Miller, F.; Noring, J.E.; Worth, D. (Lawrence Berkeley Lab., CA (USA)). 24 Dec 1986. Contract AC03-76SF00098. 65p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87013956.

This report describes the research program at Lawrence Berkeley Laboratory during FY 1985-1986 to investigate a unique solar receiver concept embodying the above principle. In this receiver, a gas-particle mixture directly absorbs concentrated sunlight to drive an endothermic chemical reaction for the production of a useful fuel or chemical. This solar receiver is called STARR, an acronym for Solar Thermally Activated Reactor. The objective of the research is to understand the optical, thermodynamic, and chemical processes in solar heated particle suspensions through a balanced program of analytical and experimental investigations. This work was built upon previous work in using gas-particle mixtures to heat a gas, which culminated in the successful test of the concept in 1982.

43177 **(N—87-22802) Impact of thermal energy storage properties on solar dynamic space power conversion system mass.** Juhasz, A.J.; Coles-Hamilton, C.E.; Lacy, D.E. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1987. 10p. (NASA-TM—89909; E—3601; NAS—1.15:89909; AIAA—87-9442; CONF-870804—31). NTIS, PC A02/MF A01.

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

A 16 parameter solar concentrator/heat receiver mass model is used in conjunction with Stirling and Brayton Power Conversion System (PCS) performance and mass computer codes to determine the effect of thermal energy storage (TES) material property

changes on overall PCS mass as a function of steady state electrical power output. Included in the PCS mass model are component masses as a function of thermal power for: concentrator, heat receiver, heat exchangers (source unless integral with heat receiver, heat sink, regenerator), heat engine units with optional parallel redundancy, power conditioning and control (PC and C), PC and C radiator, main radiator, and structure. Critical TES properties are: melting temperature, heat of fusion, density of the liquid phase, and the ratio of solid-to-liquid density. Preliminary results indicate that even though overall system efficiency increases with TES melting temperature up to 1400 K for concentrator surface accuracies of 1 mrad or better, reductions in the overall system mass beyond that achievable with lithium fluoride (LiF) can be accomplished only if the heat of fusion is at least 800 kJ/kg and the liquid density is comparable to that of LiF (1880 kg/cu m.)

1408 Ocean Energy Systems

43178 **(AD-A—180792/4/XAB) Project execution plan for OTEC (Ocean Thermal Energy Conversion) current study.** Mendelsohn, S. (Naval Facilities Engineering Command, Washington, DC (USA). Chesapeake Div.). Nov 1978. 13p. (CHES/NAVFAC-FPO—7821). NTIS, PC A02/MF A01.

As part of the Ocean Thermal Energy Conversion (OTEC) project, the contractor being sponsored by the Department of Energy, Deep Oil Technology, Incorporated, the contractor is conducting a verification test for the OTEC Cold Water Pipe during November and December 1978. The test is being conducted from the Deep Oil X-1 platform to: 1) test the analytical methods used to design the OTEC Cold Water Pipe; and 2) evaluate the performance of the Cold Water Pipe in the open sea. The work is being carried out off the Coast of California on the seaward side of Santa Catalina Island in about 1000 feet of water. The Cold Water Pipe tests will consist of supporting an instrumented steel pipe five feet in diameter and up to 800 feet long from the Deep Oil X-1. The dynamic behavior of the pipe will be measured for various sea conditions, platform motions, pipe lengths, and pipe supporting means.

1409 Solar Thermal Utilization

REFER ALSO TO CITATION(S) 43188, 43446

43179 **(EUR—10332) Study and development of a manufactured solar passive window.** Sidoroff, S. (Commission of the European Communities, Luxembourg). 1985. 81p. (In French). NTIS (US Sales Only), PC A05/MF A01. File Number DE87753140.

A multidisciplinary approach of the window as an architectural part of the building, a passive solar component and manufactured product leaded to build up the prescriptions list of a facade component standing from floor to ceiling and constituted by: - A PVC window with double glazing (with 12 mm air layer), - a night insulation manageable from inside: an exterior PVC roll blind or interior shutters. - An efficient movable shading device constituted by an exterior fabric roll blind, an interior vertical sliding claustra, or the exterior PVC roll blind. - A rigid frame made of moulded polyester reinforced with glass fibres which makes the block self-supporting and bearing the various devices of fixation of the wall. A wooden prototype has been built.

43180 **(SAND—85-2318-Rev.) Custom Engineering, Incorporated Modular Industrial Solar Retrofit qualification test results.** Cameron, C.P.; Dudley, V.E. (Sandia National Labs., Albuquerque, NM (USA); EG and G Washington Analytical Services, Inc., Albuquerque, NM (USA)). Apr 1987. Contract AC04-76DP00789. 94p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87012518.

Under the Department of Energy's Modular Industrial Solar Retrofit project, industrial process steam systems incorporating line-focus solar thermal collectors were designed and hardware was installed and tested. This report describes the test results for the system designed by Custom Engineering, Incorporated. The test series included function and safety tests to determine that the system operated as specified, an unattended operations test to demonstrate automatic operation, performance tests to provide a database for predicting system performance, and life cycle tests to evaluate component and maintenance requirements. Component-level modifications to improve system performance and reliability were also evaluated.

43181 **(SERI/SP—271-2892) Engineering principles and concepts for active solar systems.** Hunn, B.D.; Carlisle, N.; Franta, G.; Kolar, W. (eds.). (Solar Energy Research Inst., Golden, CO (USA)). Jul 1987. Contract AC02-83CH10093. 291p. NTIS, PC A13. File Number DE87001181.

This publication is a much refined and updated version of a solar design handbook originally prepared in 1978 to accompany a series of week-long courses conducted in support of the Solar Federal Buildings Program. The 1978 material was published in 1981 as the Solar Design Workbook (SERI/SP-62-308). This current document represents the culmination of an eight-year effort to compile a comprehensive state-of-the-art reference and instructional tool for practicing design professionals, architects, and engineers. It is intended to cover all phases of the design and installation of active solar energy systems for buildings. Although it contains many design guidelines, the emphasis is on providing sufficient knowledge of how these systems work to allow an engineer or architect to make well-informed decisions. It is aimed primarily at commercial building applications, but most of the material is also applicable to residential buildings.

1410 Solar Collectors And Concentrators

43182 **(CSTB-R—36-85-L) Reliability and durability of solar heat collectors.** Chevalier, J.L.; Rubinstein, M. (Centre Scientifique et Technique du Batiment, 75 - Paris (France)). May 1986. 17p. (In French). NTIS (US Sales Only), PC A02. File Number DE87753174.

One hundred solar installations, operating for 2 to 10 years, were examined to study the working reliability and durability of solar heat collectors. The results deal with installation characteristics, disorders noted on the collector, but they also contain information pertinent to the entire installation and its functioning. The interpretation was oriented toward the deterioration of collectors and a classification of the most frequent disorders leading to a typical deterioration scenario. The most sensitive component is the box-cover connection; most of the disorders observed arise from its deterioration. It was also noted that although most of the installations inspected remained in proper operating condition, particularly on single family dwellings, too many of them were defective through lack of proper maintenance. The results of this work contribute to improvements in manufacturing and to supporting the qualification procedures set up.

43183 **(FRNC-TH—2407) Contribution to the study of the efficiency increase of a flat-plate solar collector using a lamellar structure.** Zugari, M.R. (Poitiers Univ., 86 (France)). 1984. 214p. (In French). NTIS (US Sales Only), PC A10/MF A01. File Number DE87753160.

The determination by simulation and numerical parametric study of the optimal geometry of a inclined lamelled glass solar collector is exposed. The realization of a prototype and the determination of its performances by a simulation has been carried out and compared with performances of a classical flat-plate collector.

43184 **(FRNC-TH—2664) Structural analysis of the partially decentralized observation. Application to failure diagnostic of a solar power plant.** Nerin, G. (Institut National Polytechnique, 31 - Toulouse (France)). 1984. 369p. (In French). NTIS (US Sales Only), PC A16/MF A01. File Number DE87753159.

Application of the structural analysis at the automatic control of solar power plant for the failure detection in the heliostat field has been carried out for the Themis solar plant.

43185 **(N—87-21994) Structural concepts for large solar concentrators. Final report.** Hedgepeth, J.M.; Miller, R.K. (Astro Aerospace Corp., Carpinteria, CA (USA)). 1987. 66p. (NASA-CR—4075; NAS—1.26:4075). NTIS, PC A04/MF A01.

The Sunflower large solar concentrator, developed in the early 1970's, is a salient example of a high-efficiency concentrator. The newly emphasized needs for solar dynamic power on the Space Station and for large, lightweight thermal sources are outlined. Existing concepts for high efficiency reflector surfaces are examined with attention to accuracy needs for concentration rates of 1000 to 3000. Concepts using stiff reflector panels are deemed most likely to exhibit the long-term consistent accuracy necessary for low-orbit operation, particularly for the higher concentration ratios. Quantitative results are shown of the effects of surface errors for various concentration and focal-length diameter ratios. Cost effectiveness is discussed. Principal sources of high cost include the need for various dished panels for paraboloidal reflectors and the expense of ground testing and adjustment. A new configuration is presented addressing both problems, i.e., a deployable Pactruss backup structure with identical panels installed on the structure after deployment in space. Analytical results show that with reasonable pointing errors, this new concept is capable of concentration ratios greater than 2000.

43186 **(N—87-21999) Effect of an oxygen plasma on uncoated thin aluminum reflecting films.** Parsons, R.L.; Gulino, D.A. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). May 1987. 17p. (NASA-TM—89882; E—3564; NAS—1.15:89882). NTIS, PC A02/MF A01.

Thin aluminum films were considered for use as a reflective surface for solar collectors on orbiting solar dynamic power systems. A matter of concern is the durability of such reflective coatings against oxidative attack by highly reactive neutral atomic oxygen, which is the predominate chemical specie in low Earth orbit. Research to date was aimed at evaluating the protective merit of thin dielectric coatings over the aluminum or other reflective metals. However, an uncoated aluminum reflector may self-protect by virtue of the oxide formed from its exposed surface, which constitutes a physical barrier to further oxidation. This possibility was investigated, and an attempt was made to characterize the effects of atomic oxygen on thin Al films using photomicrographs, scanning electron microscopy, spectrophotometry, Auger analysis, and mass measurements. Data collected in a parallel effort is discussed for its comparative value. The results of the investigation of uncoated aluminum supported the self-protection hypothesis, and importantly, it was found that long term specular reflectance for uncoated aluminum exceeded that of Al and Ag reflectors with dielectric coatings.

43187 **(VPI-E—85.28) Analysis of a thin-film solar collector.** Thomas, W.C.; Eiss, N.S. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Dept. of Mechanical Engineering). Nov 1985. Contract AC03-83SF11922. 96p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87013945.

The thermal performance and structural characteristics of a thin-film collector have been analyzed to support the Reynolds Metals Company in developing an advanced monocoque configuration. The collector consists of a formed one-piece insulating core and a thin aluminum foil-polymer film laminate absorber completely enclosed by a polymeric glazing material which also serves as a stressed skin. The effects of nonuniformities in the flow distribution within the absorber and within an array consisting of ten collectors were also modeled.

1420 Heat Storage

43188 **(AFME—83-2360) Evaluation of medium term development prospects of solar heating systems with seasonal storage.** (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1984. 94p. (In French). NTIS (US Sales Only), PC A05/MF A01. File Number DE87753156.

An IEA (International Energy Agency) research analysis concerning experimental solar heating systems with seasonal storage (latent heat storage, chemical storage, sensible heat storage) throughout the world is presented. Numerous data are given. Sensible heat storage systems are the most studied: burried vertical heat exchangers, aquifer and geothermal storage. Reliable and operational design tools are also proposed, and among them TRNSYS programs, specially adapted by Lund university, are particularly well suited for the study and optimization of such systems. A specification sheet for French demonstration projects to be realized is then described.

15 GEOTHERMAL ENERGY

1501 Resource Status And Assessment

43189 **(SAND—87-0923C) Recent progress in magma energy extraction.** Ortega, A.; Dunn, J.C.; Chu, T.Y.; Wemple, R.P.; Hickox, C.E. (Sandia National Labs., Albuquerque, NM (USA); Utah Univ., Salt Lake City (USA)). 1987. Contract AC04-76DP00789. 8p. (CONF-8704110—13). NTIS, PC A02. File Number DE87013083.

From 5. geothermal program review; Washington, DC, USA (14 Apr 1987).

Ongoing research in the area of Magma Energy Extraction is directed at developing a fundamental understanding of the establishment and long term operation of an open, direct-contact heat exchanger in a crustal magma body. The energy extraction rate has a direct influence on the economic viability of the concept. An open heat exchanger, in which fluid is circulated through the interconnecting fissures and fractures in the solidified region around drilling tubing, offers the promise of very high rates of heat transfer. This paper discusses recent research in five areas: (1) fundamental mechanisms of solidifying and thermally fracturing magma; (2) convective heat transfer in the internally fractured solidified magma; (3) convective flow in the molten magma and heat transfer from the magma to the cooled heat exchanger protruding into it; (4) numerical simulation of the overall energy extraction process; and (5) the thermodynamics of energy conversion in a magma power plant at the surface. The studies show that an open heat exchanger can be formed by solidifying magma around a cooled borehole and that the resulting mass will be extensively fractured by thermally-induced stresses. Numerical models indicate that high quality thermal energy can be delivered at the wellhead at nominal rates from 25 to 30 MW electric. It is shown that optimum well circulation rates can be found that depend on the heat transfer characteristics of the magma heat exchanger and the thermodynamic power conversion efficiencies of the surface plant.

1502 Geology And Hydrology Of Geothermal Systems

REFER ALSO TO CITATION(S) 44219

43190 **(DOE/ID/12526—T2) Investigation of the thermal regime and geologic history of the Cascade volcanic arc: First phase of a program for scientific drilling in the Cascade Range.** Priest, G.R. (Oregon State Dept. of Geology and Mineral Industries, Portland (USA)). 1987. Contract FG07-84ID12526. 137p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87013077.

A phased, multihole drilling program with associated science is proposed as a means of furthering our understanding of the thermal regime and geologic history of the Cascade Range of Washington, Oregon, and northern California. The information obtained from drilling and ancillary geological and geophysical investigations will contribute to our knowledge in the following general areas: (1) the magnitude of the regional background heat flow of parts of the Quaternary volcanic belt dominated by the most abundant volcanic rock types, basalt and basaltic andesite; (2) the nature of the heat source responsible for the regional heat-flow anomaly; (3) the characteristics of the regional hydrothermal and cold-water circulation; the rates of volcanism for comparison with models for the rate and direction of plate convergence of the Cascades; (5) the history of deformation and volcanism in the volcanic arc that can be related to subduction; (6) the present-day stress regime of the volcanic arc and the relation of these stresses to plate interactions

and possible large earthquakes; and the current geometry of the subducted oceanic plate below the Cascade Range and the relationship of the plate to the distribution of heat flow, Quaternary volcanism, and Quaternary deformation. Phase I research will be directed toward a detailed investigation of the Santiam Pass segment. In concert with the Santiam Pass research, a detailed study of the nearby Breitenbush Hot Springs area is also recommended as a component of Phase I. The object of the Breitenbush research is to study one of the hottest known Cascade hydrothermal systems, which coincidentally also has a good geological and geophysical data base. A coordinated program of drilling, sampling, subsurface measurements, and surface surveys will be associated with the drilling of several holes.

1503 Geothermal Exploration And Exploration Technology

REFER ALSO TO CITATION(S) 43192

43191 (DOE/ET/27014—T20) The 1985 Geothermal Gradient Drilling Project for the State of Washington. Barnett, B. (Washington State Dept. of Natural Resources, Olympia (USA). Div. of Geology and Earth Resources). Feb 1986. Contract AC07-79ET27014. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013389.

This report describes seven geothermal gradient test holes in the southern Washington Cascade Mountains. The objectives of the drilling program were to: (1) more accurately define the general extent of potential geothermal resources in the southern Washington Cascades, and (2) evaluate specific targets that are geologically and structurally favorable for the occurrence of geothermal resources. (ACR)

1509 Geothermal Engineering

43192 (PNL—6227) R and D, fabrication and testing of pH and CO_2 sensors for geothermal brines. Baxter, R.D.; Clack, P.J.; Phelan, D.M.; Taylor, R.M. (Leeds and Northrup Instruments, North Wales, PA (USA); Pacific Northwest Lab., Richland, WA (USA)). Mar 1987. Contract AC06-76RL01830. 96p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87013582.

Reduction or elimination of scaling is a mandatory requirement for the operation of geothermal power plants. The use of downhole sampling and subsequent analysis for solution chemistry has many disadvantages. These disadvantages include composition change with cooling, risk of sample contamination, and non real-time indication. The use of in-line sensing of solution chemistry avoids these drawbacks but requires sensors which can survive the extremely harsh environment of brine at high temperatures and elevated pressures. Leeds & Northrup had previously undertaken a contract to develop sensors for pH and pCO_2 which would withstand these harsh environments. A number of sensors were tested at a field site under actual operating conditions. Field test results indicated that certain facets of the design were inadequate to give accurate long term measurement. The primary areas addressed here are replacement of polymeric seals with anodic bonding where possible, improved methods of lead attachment, improved sealing of the pCO_2 reference feed-through, H_2S getter optimization and improved passivation of the sensing head. Each of these areas is addressed in detail in the report along with laboratory test results pertaining to the particular phase.

17 WIND ENERGY

43193 (ECN-PB—87-1) Wind power for households. 1. The experimental project Camperduin. Boone, M.J.; van Hulle, F.J.L.; Westra, C.; Wolsink, M. (Netherlands Energy Research Foundation, Petten). 1987. 209p. (In Dutch). NTIS (US Sales Only), PC A10/MF A01. File Number DE87752775.

The practical aspects of the utilization of wind energy for the supply of electricity to a group of 28 family dwellings were investigated in an experimental project, set up at the coastal village Camperduin. This project was carried out within the framework of the National Wind Energy Development Program (NOW II), under the main subject: decentralized applications of wind energy. The wind turbines, two 25 kW Lagerwey machines, were installed on the local grid, operated and maintained by the provincial utility company PEN. A study of the possibilities of voluntary load management was carried out by the University of Amsterdam (IVAM). ECN was responsible for the measurements and the investigation of the wind regime and the behavior and performance of the wind turbines. The results, measurements and experiences obtained during 2.5 years of continuous monitoring are described. Areas of particular interest were a.o. the various experiences with the operation of the wind turbines, the performance of the machines (variable speed, AC/DC/AC system), the energy production and consumption and the direct use of the wind energy in relation to the wind regime, and the analysis of the consumers behavior as influenced by stimuli towards voluntary load management.

1701 Availability (climatology)

REFER ALSO TO CITATION(S) 43199

43194 (ECN—87-074) Wind observations on the terrain of ECN (1985-1986). Lekkerkerk, F.; Van Rijswijk, J.U. (Netherlands Energy Research Foundation, Petten). May 1987. 78p. (In Dutch). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

This report is a compilation of data on wind distribution (velocity and direction) on the ECN-terrain during the years 1985-1986.

43195 (THE-R—818-D) A method to obtain a wind model for the boundary layer in a representative tropical region. Abu Bakr, E.H.; Rutten, M.; Smulders, P.T.; Vossers, G.; Wieringa, J. (Technische Hogeschool Eindhoven (Netherlands). Afdeling Technische Natuurkunde). Oct 1986. 5p. (CONF-861062—9). Technical Univ. Eindhoven, Physics Dept., P.O. Box 513, 5600 MB Eindhoven, Netherlands.

From European wind energy conference; Rome, Italy (7 Oct 1986).

Presented at the 6. European wind energy conference, Rome, Italy, 7-9 October 1986.

The construction of a reference data base which can be used for developing a boundary layer model for tropical regions is discussed. The representative region selected for the investigation is an area of 20,000 sq. km around Khartoum (Sudan). The assembled surface wind data are corrected for exposure, and their reliability is checked. It is shown, that due to the seasonal influence of the Intertropical-Convergence-zone any full-year representation of wind frequency distribution is misleading and that seasonal analysis is required. The average wind profile to 2 km height shows a jet-like appearance, which invalidates the use of simole relations between large-scale free atmospheric wind and surface wind climate. It is shown that for the winter season an Ekman wind profile with thermal wind modification might prove useful. 5 figs., 12 refs.

43196 Wind energy resource assessment of Egypt. Elliott, D.L.; Renne, D.S.; Bassyouni, K. (Battelle Pacific Northwest Labs., Richland, WA). pp 215-216 of Sixth ASME wind energy symposium. Thresher, R.W. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870210—).

From 10. energy sources technology conference and exhibition; Dallas, TX, USA (15 Feb 1987).

The authors present an assessment of wind characteristics in Egypt with identified areas of outstanding wind resource potential for wind turbine applications. This discussion highlights major findings of an initial analysis of the estimated wind resource distribution throughout all of Egypt, based largely on historical meteorological data; results of recent field measurement programs to update the wind resource estimates for specific areas of Egypt and to evaluate candidate sites for wind-energy use; and current studies for assessing the spatial variability of the resource and its interannual variability in specific areas of Egypt.

1706 Wind Energy Engineering

REFER ALSO TO CITATION(S) 43237

43197 (DOE/NASA/20320—72) Surface pressure measurements on the blade of an operating Mod-2 wind turbine with and without vortex generators. Nyland, T.W. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Aug 1987. Contract AI01-76ET20320. 37p. (NASA-TM—89903). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013854.

Pressure measurements covering a range of wind velocities were made at one span location on the surface of an operating Mod-2, 2500-kW, wind turbine blade. The data, which were taken with and without vortex generators installed on the leading edge, show the existence of higher pressure coefficients than would be expected from two-dimensional wind tunnel data. These high pressure ratios may be the result of three-dimensional flow over the blade, which delays flow separation. Data are presented showing the repetitiveness of abrupt changes in the pressure distribution that occur as the blade rotates. Calculated values of suction and flap coefficients are also presented.

43198 (ECN—87-053) The wind energy scene in The Netherlands and the role of ECN. Dragt, J.B. (Netherlands Energy Research Foundation, Petten). Apr 1987. 6p. (CONF-8703171—1). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

From BWEA annual conference; Edinburgh, UK (31 Mar 1987).

In May 1986 the new 'Integral Program for Wind Energy' (IPW) for the years 1986-1990 was published. It includes opportunities for both investment and development subsidies. The mechanism of the plan is explained, including tasks of the coordinating agencies (PEO and NEOM), available budgets, and rules for the amounts of subsidy. Next to this IPW a new (the third) research program has been started, named NOW-3. The main lines of this program are discussed. The Netherlands Energy Research Foundation ECN is taking an active part in these programs. The paper will elaborate on the 'restricted quality certificate', issued by ECN. Apart from that ECN is working under contract with manufacturers on their wind turbine development. Some tasks are performed directly for the coordinating agencies and research is done within the framework of NOW-3. Finally the present status of the programs will be mentioned. In particular the alleviated certification procedure that had to be followed by the end of 1986 will be discussed. In spite of some flaws in the regulation that had to be handled, the IPW is expected to be an essential tool for stimulating the market and to reach the long term goals for wind energy application in the Netherlands. 4 tabs., 6 refs.

43199 (KEMA-DPA—641-85) Site selection for wind power plants in the province of Friesland, Netherlands. Pheifer, L.R. (Keuring van Electrotechnische Materialen N.V., Arnhem (Netherlands)). Feb 1986. 69p. (In Dutch). N.V. KEMA, P.O. Box 9035, 6800 ET Arnhem, Netherlands.

Investigation into locations in the province of Friesland, Netherlands, fit for centralized electric power generation by big wind turbines.

43200 (THE-R—812-D) The physics and mathematical description of the Achilles heel of stationary wind turbine aerodynamics: the tip flow. Van Kuik, G.A. (Technische Hogeschool Eindhoven (Netherlands). Afdeling Technische Natuurkunde). Oct 1986. 6p. (CONF-861062—8). Technical Univ. Eindhoven, Physics Dept., P.O. Box 513, 5600 MB Eindhoven, Netherlands.

From European wind energy conference; Rome, Italy (7 Oct 1986).

Presented at the 6. European wind energy conference, Rome, Italy, 7-9 October 1986.

By comparison of wing theory with rotor theory the significant influence of the blade tip load and tip vortex on the non-linear flow behavior is shown. This non-linearity is commonly neglected in wing theory, but is not to neglect in rotor theory. All rotors are loaded not only by axial and tangential forces but also by radial forces. In the mathematical limit of the actuator disc these forces appear as a discrete edge force. Extension of the axial momentum theory with these tipforces leads to a higher maximum C/sub p/ and C/sub T/. 9 figs., 9 refs.

43201 (THE-R—815-D) Pump research by CWD: the influence of starting torque of single acting piston pumps on water pumping windmills. Cleijne, H.; Smulders, P.; Verheij, F.; Oldenkamp, H. (Technische Hogeschool Eindhoven (Netherlands). Afdeling Technische Natuurkunde). Oct 1986. 5p. (CONF-861062—11). Technical Univ. Eindhoven, Physics Dept., P.O. Box 513, 5600 MB Eindhoven, Netherlands.

From European wind energy conference; Rome, Italy (7 Oct 1986).

Presented at the 6. European wind energy conference, Rome, Italy, 7-9 October 1986.

Piston pumps are difficult to match to windmills. In first approximation the pump demands a constant torque for all rotational speeds. For this reason the combination of windmill and pump reaches its maximum performance for a single windspeed called the design windspeed. At standstill the mill only starts running when the windspeed is higher than about 1.5 the design windspeed. It stops only when the windspeed drops below V/sub stop/ which is lower than the design windspeed. In the intermediate region the windmill is sometimes running, sometimes standing still. By this fact the overall efficiency is lower than can be expected theoretically. The introduction of start helps can improve the start behavior considerably. A newly developed start help i.e. the floating valve is presented. A simple theoretical model of the floating valve is given, which is in fair agreement with the performed experiments. The pump with floating valve was tested under laboratory conditions as well as under field conditions. Comparison of the performance of a mill equipped with a normal pump and a pump with a floating valve showed an improved start behavior and a 60% increased overall efficiency. 10 figs., 5 refs.

43202 (THE-R—816-D) Field testing of water pumping windmills by CWD. Van Meel, J.; Smulders, P.; Oldenkamp, H.; Van de Nat, A.; Lysen, E. (Technische Hogeschool Eindhoven (Netherlands). Afdeling Technische Natuurkunde). Oct 1986. 8p. (CONF-861062—10). Technical Univ. Eindhoven, Physics Dept., P.O. Box 513, 5600 MB Eindhoven, Netherlands.

From European wind energy conference; Rome, Italy (7 Oct 1986).

Presented at the 6. European wind energy conference, Rome, Italy, 7-9 October 1986.

Field testing of water pumping windmills is an important part of CWD's activities. Measurements are performed by means of Apple II computers and thereafter elaborated by means of the same computers, using software developed by the Wind Energy Group. Some aspects related to the hysteresis behavior of windmills driving piston pumps are discussed. The behavior of a windmill in the hysteresis region depends on the history of the wind speed. Therefore the average curves measured according to the generally accepted IEA recommendations depend on the frequency distribution and time history of the wind speed during the measurements. The IEA practices were conceived to provide a means of measuring output curves in a reproducible way. The underlying assumption is that an output curve is a characteristic of a wind machine, valid at any site, in any wind regime. As indicated above, this is not the case for windmills driving piston pumps, or for that matter for any wind machine, having hysteresis behavior. Two examples are presented of output curves, measured for one machine at one site under different wind conditions. Considerable differences were found. Annual water outputs calculated on the basis of the two curves can differ as much as a factor of two. Procedures for output prediction of water pumping windmills will have to involve three steps instead of two. The procedure must start by determining an output curve, including hysteresis effect, which only depends on characteristics of the wind machine. Subsequently the curve must be converted into a simple but site specific curve by means of probabilities derived from the site's wind speed frequency distribution. The third step is the conventional multiplication and integration of

output curve and frequency distribution. A simple theoretical model has been developed including these three steps. Procedures for field measurements based on this concept will need to be developed. 10 figs., 7 refs.

43203 **(THE-R—817-D) Wind energy for water pumping in developing countries.** Smulders, P.T. (Technische Hogeschool Eindhoven (Netherlands). Afdeling Technische Natuurkunde). Oct 1986. 8p. (CONF-861062—12). Technical University Eindhoven, Physics Dept., P.O. Box 513, 5600 MB Eindhoven, Netherlands.

From European wind energy conference; Rome, Italy (7 Oct 1986).

Windpumpers can be used for different applications: domestic water supply, animal husbandry, irrigation, drainage and salterns. The most important type of windpumper is the classical American multi-blade windmill driving a piston pump. Capital investment is typically $400-$500 per m/sup 2/ rotor area. Maintenance and repair, however, pose so many problems that effective water output can be very low, owing to stand still. Probably well over half a million of these mills are in use today. To design more cost-effective windpumpers the aim is a modern, efficient, light, all metal construction. Substantial progress has been made in these designs; the author gives an overview on current technological developments and future prospects. In Sri Lanka the Wind Energy Unit was able to have 3 m-windpumps manufactured and installed for $140 per m/sub 2/, in Kenya the Kijits windpump costs about $300 per m/sub 2/. Other types of windpumps use screwpumps or centrifugical pumps: some of them with electrical transmission between the wind generator and the pump, others use pneumatic transmission which requires an air compressor. The author concludes with some remarks on economics, lack of testing data and field experiences. 5 figs., 15 refs.

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43204 **(EPRI-AP—5341) Acoustic flow measurement evaluation project: Summary report: Final report.** Lang, J.H.; Thomas, D.R.; Beauchamp, C.H. (Electric Power Research Inst., Palo Alto, CA (USA); British Columbia Hydro and Power Authority, Vancouver (Canada)). Aug 1987. 136p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920544.

The Electric Power Research Institute (EPRI) initiated and co-sponsored a series of flow measurement comparison tests at three different sites in the USA and Canada. The primary objective of the comparative testing was to provide verification of the technical performance of the acoustic flowmeter system as compared to other systems of flow measurement which are currently code accepted. A secondary objective was to provide substantive test results which will be made available to the respective committees of the national and international organizations concerned with testing procedures for their consideration in adopting the acoustic flowmeter system as a code accepted system. The comparison tests were carried out as turbine and/or pump performance tests. Individual site reports were issued which contain the results and details of the test procedures and methods used at each of the sites. This report attempts to summarize and analyze the data collected at the three test sites. The report concludes that the acoustic methods results are as reliable as those of any of the code approved methods used and that the systematic uncertainties of the acoustic method are estimated to be +-1% to +-2%. The conclusion is also drawn that the values of the systematic uncertainties as published in the various codes for the code approved methods used are realistic. The report recommends that the acoustic systems as implemented by Westinghouse's Leading Edge flowmeter and Ferranti O.R.E.'s Accusonic Flowmeter be included in the aforementioned codes and that, due to the lack of the reliable comparison data between flow measurement methods, EPRI encourages and assists utilities to use more than one method of flow measurement during acceptance tests. This information would be then compiled into a flow comparison data bank. 12 refs., 9 figs., 58 tabs.

43205 **(EPRI-CS—5275) Water, steam, and turbine deposit chemistries in phosphate-treated drum boiler units: Final report.** Jonas, O. (Jonas, Inc., Wilmington, DE (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Aug 1987. 151p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920540.

This report presents results obtained in several EPRI projects under RP1886, The Effect of Phosphate on Turbine Components. The main thrust of this project was to investigate the possible role that the phosphate boiler water chemical treatment has on the integrity of steam turbine blades. Only drum boiler units using phosphate boiler water treatment are included in this study. Information on concentration and transport of chemical impurities and sodium phosphate around drum boiler cycles was collected and correlated with chemical composition of low pressure (LP) turbine deposits collected after the water and steam sampling. Correlation of results of turbine inspections (reported as blade and disc cracking) revealed that turbines which did not have cracking in LP turbines had a higher concentration of phosphate in deposits and higher carry-over and turbines with HP blade cracking had a high concentration of sodium in deposits. The effects of water and steam chemistry on blade corrosion were also assessed from the deposit chemistry combined with corrosion fatigue and other corrosion data on turbine materials reported elsewhere. About 50% of the turbines for which deposits were collected had chloride and sulfate in deposits at concentrations above 0.25 wt %, which can potentially be corrosive. A comparison of concentrations of impurities to the limits recommended in the EPRI Interim Consensus Guidelines (6) is also presented. It shows that the limits for chloride and sulfate for boiler water and steam can easily be met, but that the congruent or coordinated phosphate boiler water treatment control is difficult to maintain. 34 refs.

43206 **(EPRI-NP—5159M) Guidelines for specifying integrated computer-aided engineering applications for electric power plants: Final report.** Thomas, K.D.; Murphy, T.A.; Andersen, K.R.; Rhodes, D.M.; Cimento, A.P.; Wilber, B.E. (Duke Power Co., Charlotte, NC (USA); Westinghouse Electric Corp., Pittsburgh, PA (USA); Cygna Corp., San Francisco, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). May 1987. 231p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920495.

Many computer-aided engineering (CAE) applications are being developed for power plant activities in a stand-alone fashion. This results in costly redundant handling and maintenance of data by these applications. A data model covering the entire power plant life cycle is needed to integrate the data requirements of these power plant activities and to provide a foundation for the development of CAE applications. A project has been sponsored to develop this data model as part of a larger network of plant information called the "Plant Information Network" (PIN). The Plant Information Network is based on fundamental principles of Information Engineering. The PIN combines the data requirements for design, construction, and operation activities to provide a thorough understanding of the flow of information throughout the entire power plant life cycle. Additionally, the PIN provides the basis of an industry standard for the effective exchange of plant information between an electric utility and its suppliers. This final report is the Guidelines Report developed for using the PIN. This Guidelines Report enables electric utility engineers to prepare specifications for CAE applications that will integrate common data requirements across the entire spectrum of generating plant work activities.

43207 **(INIS-mf—10646) Simulation of transverse vibrations of narrow buildings caused by wind forces, using autonomous differential equations.** Schliephake, C. (Technische Univ. Braunschweig (Germany, F.R.). Fachbereich fuer Bauingenieur- und Vermessungswesen). 18 Dec 1984. 142p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE87752450.

Different possibilities of producing model calculations for the mechanism of turbulent excitation of cylindrical profiles (e.g. chimneys) are examined. A phenomenological air force model was developed. The effect of the flow field on the circular profile was

replaced by the effect of an active non-linear single mass system coupled to the structure. Qualitative and quantitative agreement is obtained between the calculated results and the measurements. The model is explained for the dynamic analysis of a vibration damper.

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REFER ALSO TO CITATION(S) 42969, 42976, 43480, 43813, 43970

43208 **(ANL/EES-TM—334-Vol.1) Solid waste leachate data review: Volume 1: Summaries of fluidized-bed combustion and flue-gas desulfurization research programs.** Kaszynski, G.M.; Helm, S.T. (Argonne National Lab., IL (USA). Energy and Environmental Systems Div.). Jun 1987. Contract W-31109-ENG-38. 64p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87012855.

Solid waste leachate data were compiled for research programs on fluidized-bed combustion (FBC) and flue-gas desulfurization (FGD). The research programs were sponsored primarily by the US Department of Energy, the US Environmental Protection Agency, and the Electric Power Research Institute. The resulting matrices present essential administrative information (sponsoring entity, technical coordinator, research period, etc.) and specific research data derived from research program documentation (waste type, site locations, constituents analyzed, sample size, results, etc.). Based on various leachate extraction procedures, including the EP (extraction procedure) toxicity test, the results suggest that leachates from FBC and FGD solid wastes would not be considered hazardous for the sites examined given the Resource Conservation and Recovery Act (RCRA) limit of 100 times the maximum contaminant level for the eight RCRA trace elements (As, Ba, Cd, Cr, Pb, Hg, Se, and Ag).

43209 (CONF-8610316—, pp 25.1-25.17) **Flue gas treatment (desulphurization, denitrification) in the RWE lignite-fuelled power plants - planning, licensing, environment, waste disposal.** Ortner, G. 1986. (In German). NTIS (US Sales Only), PC A99. File Number DE87752961.

From CSR symposium and exhibition concerning the planning and protection of the human environment; Duesseldorf, F.R. Germany (1 Oct 1986).

The following criteria were used in the selection of the suitable desulphurization process to meet both the requirements of pollution control and safe energy supply, and to minimize the technical and economic risks as much as possible: 1) High desulphurization level to control also the peak values in the strongly varying sulphur contents in brown coal; 2) Simple technique and technology easy to handle operationally at high availability; 3) Profitable operation with inexpensive materials; 4) Successful application in other power plants, in particular high operational reliability; 5) Broad range of supplies owing to the great number of desulphurization systems to be installed at the same time; 6) Potential for further development of the process; 7) The final products should be either usable in industry or depositable in landfills at low pollutivity.

43210 **(EPRI-CS—4439-Vol.1) Integrated environmental control: Volume 1, Sample design strategy: Final report.** Nold, D.G.; Baus, T.R.; Robie, C.P. (Stearns Catalytic Corp., Denver, CO (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jul 1987. 122p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920539.

The Volume 1 report for this study proposes an integrated design approach for coal-fired power plant environmental controls. Two characteristics distinguish the integrated environmental control (IEC) approach as defined in this study from historical design approaches. First, all major environmental control subsystems are considered to equally influence costs and overall plant performance until preliminary analysis indicates otherwise. This assures benefits derived for one subsystem (e.g., solid waste disposal) do not increase complexity for other subsystems (e.g., water management) to the level where total plant costs are higher. Second, the IEC approach maximizes compatibility between equipment, fuel properties, and site characteristics. This allows the least complex environmental control system (ECS), lowering cost and minimizing potential operating problems. The IEC design strategy, described in detail in Section 2 and Appendices A-D, can reduce ECS costs in two ways. First, the IEC approach helps insure cost savings derived for one subsystem are not offset by other increases, raising total ECS costs. Second, reliability can be increased and potential operating problems reduced if equipment and control strategies selected are most compatible with the site and fuel characteristics, and thus most simple. Selection of the best control strategy for given site and fuel characteristics is aided by a technical/economic analysis, described in Section 3, that allows ECS costs and technical features to be analyzed. 17 figs., 14 tabs.

43211 (EPRI-CS—5167-Vol.2, pp 8.1-8.18) **Advanced computer control system with on-line FGD process simulator.** Kondo, D.; Shinoda, N.; Hagiwara, S.; Kouno, S.; Watanabe, Y.; Nonogaki, Y. (Pure Air, Philadelphia, PA). May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920405. (CONF-861132—Vol.2).

From 10. symposium on flue gas desulfurization; Atlanta, GA, USA (18 Nov 1986).

A state-of-the-art computer control system for flue gas desulfurization (FGD) plants has been developed. Operation of this system has lowered FGD power consumption by as much as 12% by optimizing the process control under varying boiler loads. This system, the ASC-1000, controls absorber slurry recirculation flow rate and reagent feed rate in response to boiler load and process chemistry status estimated by a built-in process simulator. It also possesses substantial operation and maintenance management software designed to minimize operator errors, reduce staff requirements, and enhance the quality of component equipment maintenance. This system has been retrofitted on four operating scrubbers at the Nakoso Power Station, Joban Joint Power Company, Ltd. After one year of successful operation, the following results were obtained: under a boiler load change rate of five percent per minute, the control system maintained stable desulfurization performance, and this high degree of desulfurization control enabled more flexibility in adjustments to the absorber slurry recirculation flow rate. Power savings of 26 MWh per day resulted for each 600 MW unit retrofitted and, additionally, reagent savings of 5% were achieved.

43212 (EPRI-CS—5167-Vol.2, pp 8.19-8.27) **Materials of construction overview.** Koch, G.H. (Battelle Columbus Div., OH). May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920405. (CONF-861132—Vol.2).

From 10. symposium on flue gas desulfurization; Atlanta, GA, USA (18 Nov 1986).

An overview on the materials of construction presently used in flue gas desulfurization (FGD) systems is presented. Initially, the construction materials which are commonly used in the various scrubber components reviewed. Then, utility experience with several construction materials in significant scrubber components is discussed. The components of interest are; prescrubbers, absorbers, outlet ducts and stacks. Based on the discussion of the materials of construction in these components, it is concluded that a wide variety of materials can be used throughout an FGD system ranging from low cost organic linings in absorbers to ceramic linings or highly alloyed metal in venturi prescrubbers and outlet ducts. A cost effective material selection can be made by carefully considering scrubber operating conditions and the environments in the various components.

43213 (EPRI-CS—5167-Vol.2, pp 8.29-8.53) **Design and operation of a wet process based flue gas desulfurization system without reheat.** Smigelski, J.E.; Maroti, L.A. (New York State Gas and Electric Corp., Binghamton). May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920405. (CONF-861132—Vol.2).

From 10. symposium on flue gas desulfurization; Atlanta, GA, USA (18 Nov 1986).

In 1977, EPRI published Stack Gas Reheat for Wet Flue Gas Desulfurization Systems. It gave three categories of reasons for stack gas reheat. These were: (1) to enhance plume rise and dispersion of pollutions; (2) to avoid a visible plume; and (3) to avoid downstream condensation and corrosion. Included in Category 3 is rainout, acid mist fallout, or stack liquid discharge in the vicinity of

the stack. It was reported that at that time nearly all operating systems included a reheat system utilizing between 0.45 to 5.7% of the boiler system energy input. There was only a limited amount of experience without reheat, primarily on small units. There are now approximately 130 individual FGD systems, 104 of which use stack gas reheat. The median temperature rise for reheated flue gas is about 35°F. While bypass reheat is the most popular form of reheat, 75 units employ an installed external source of reheat. Of the 26 FGD systems that are designed to operate without reheat, 16 have the capability to bypass flue gas. The knowledge gained through a decade of FGD operating experiences has enabled many wet FGD systems to operate without the expense and problems of an installed reheat system. There is a strong economic incentive for operating without an installed reheat system. An overview of the design process is given and the decision to operate a wet stack using some of the new knowledge of the last decade is discussed. The methodology of a modeling investigation to develop the design of a wet duct/stack system for Somerset Station is discussed along with implementation and the history of the operation without reheat.

43214 (EPRI-CS—5167-Vol.2, pp 8.55-8.66) **Improvements of FGD system reliability at Springfield IL City Water, Light, and Power's Dallman Station.** Hargrove, O.W.; DeKraker, D.; Riordan, E.; Buecker, B.; Myers, D.; Stewart, D.A. May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920405. (CONF-861132—Vol.2).

From 10. symposium on flue gas desulfurization; Atlanta, GA, USA (18 Nov 1986).

Dallman 3 is equipped with a wet-limestone double loop FGD system. Since its start up in 1980, this FGD system has experienced problems associated with solids build up in the absorber and mist eliminator packing. In past operation, this pluggage eventually restricted gas flow and unit load. In 1984, CWL&P and EPRI began a program to improve the reliability of the Dallman system. Changes have been made in the limestone preparation area, limestone reagent control strategy, and in the process chemistry of the upper absorber loop. The effects of these changes are reported and compared with results from a similar system at Texas Utilities Generating Company's Martin Lake Steam Electric Station.

43215 (EPRI-CS—5167-Vol.2, pp 8.67-8.79) **Investigation of mist eliminator reliability problems at Utah Power and Light's Hunter Station.** Betenson, G.; Hargrove, O.W. Jr.; Brown, C.A.; DeKraker, D.P.; Stewart, D.A. (Utah Power and Light, Salt Lake City). May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920405. (CONF-861132—Vol.2).

From 10. symposium on flue gas desulfurization; Atlanta, GA, USA (18 Nov 1986).

Utah Power and Light (UP&L) has been experiencing mist eliminator reliability problems at Hunters Units 1 and 2. The FGD systems on these units are lime-based with vertical flow mist eliminators in the top of the vertical towers. These mist eliminators plug with slurry which requires extensive cleaning or replacement of the mist eliminators during each annual outage. In addition, slurry build up in the outlet ducts and in the stack build up in the outlet ducts and in the stack is severe. UP&L and EPRI have begun a program to improve the reliability of the mist eliminator system at Hunter 1 and 2. The changes made in the wash system involve wash water quality and wash duration and frequency. Changes have also been made in the lime slaking area and in low-load operating philosophy to reduce water consumption in the FGD system. Water consumption at Hunter is extremely important since the plant must operate at zero discharge.

43216 (EPRI-CS—5167-Vol.2, pp 9.1-9.21) **Limestone spray drying absorption for SO_2 control.** Joens, E.; Felsvang, K.; Madhok, R. (A/S Niro Atomizer, Copenhagen, Denmark). May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920405. (CONF-861132—Vol.2).

From 10. symposium on flue gas desulfurization; Atlanta, GA, USA (18 Nov 1986).

Flue gas desulfurization by spray drying absorption is now a well-established technology world wide with more than 12,000 MW/sub e/ contracted for. Spray dryer absorption or dry scrubbing has attracted much attention during the last 8-9 years due to its simplicity, cost effectiveness, and dry end-product. Lime, which is the preferred reagent for spray dryer absorption systems in operation, can, however, be a major operating cost disadvantage for spray dryer absorber systems. Pilot plant test work carried out to develop the use of limestone instead of lime in new as well as in existing spray dryer absorber systems is described. Niro Atomizer and other research organizations have, over the last 3-4 years, tried to use finely divided limestone as absorbent in the spray dryer absorber process. The major problems preventing the successful use of limestone have been the lack of sufficient SO_2 removal and difficult transport and handling properties of finely divided limestone. These handling and transport properties have virtually eliminated limestone from use in a spray dryer absorber system. The problems with limestone handling are identified and pilot plant tests that successfully have led to a solution of the problems mentioned are discussed. At current development status, at least 75-80% SO_2 removal can be achieved for a medium sulfur coal (1500 ppm SO_2) with a limestone stoichiometry of 1.5.

43217 (EPRI-CS—5167-Vol.2, pp 9.23-9.31) **Comparison of dry scrubbing operation of Laramie River and Craig Stations.** Doyle, J.B.; Jankura, B.J.; Vetterick, R.C. (Babcock and Wilcox Co., Alliance, OH). May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920405. (CONF-861132—Vol.2).

From 10. symposium on flue gas desulfurization; Atlanta, GA, USA (18 Nov 1986).

An overview and comparison of the operation of the first two commercial dry sulfur removal (DSR) systems designed, built, and installed by The Babcock and Wilcox Company (B & W) are presented. The first unit was installed at the Missouri Basin Power Project, Laramie River Station, and the second unit was installed at the Colorado Ute Craig Station. Both of these units are very similar in regards to the basic design principles, but there are a number of unique features that have had a significant effect on the operation of the systems. These differences and their effects are discussed. The major area of discussion is centered around the chemical composition of the fly ash and the type of particulate collector used.

43218 (EPRI-CS—5167-Vol.2, pp 9.33-9.52) **Dry scrubber operating experience at the North Valmy Station.** Smith, L.; Garrity, L.; Goffredi, R. (Sierra Pacific Power Co., Reno, NV). May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920405. (CONF-861132—Vol.2).

From 10. symposium on flue gas desulfurization; Atlanta, GA, USA (18 Nov 1986).

The North Valmy Station is a coal fired power plant located in north-central Nevada. It is owned by Sierra Pacific Power Company and Idaho Power Company. Unit 2 at North Valmy is a 267 MW unit that utilizes a General Electric turbine, Foster Wheeler boiler, Combustion Engineering dry scrubber, and Flakt baghouse. The dry scrubber system has been in operation since March 1985. It has achieved anticipated sulfur dioxide removal efficiencies and lime consumption rates while experiencing relatively few operating problems. The equipment design and the operating experience to date are reviewed.

43219 (EPRI-CS—5167-Vol.2, pp 9.53-9.68) **Joy/Niro utility spray dryer FGD operating experience: an update.** Donnelly, J.R.; Tracy, G.W.; Quach, M.T.; Felsvang, K.S.; Eriksen, R.L.; Eutizi, J.G. (Joy Manufacturing Co., Los Angeles, CA). May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920405. (CONF-861132—Vol.2).

From 10. symposium on flue gas desulfurization; Atlanta, GA, USA (18 Nov 1986).

Since the last FGD symposium in June 1985, four additional Joy/Niro utility spray dryer absorption (SDA) FGD systems have started up, bringing the number of commercial operating units to eight, representing a total of 2650 MWe of generating capacity. Three of these units have undergone compliance/performance testing: Springerville Generating Station Unit No. 1; Antelope Valley Station Unit No. 2; and, VKG Kraftwerk Durnrohr Unit No. 1.

The fourth unit, Wyodak Generating Station Unit No. 1, is the first retrofit application of an SDA system upstream of an existing electrostatic precipitator (ESP) and is currently in the initial performance test phase. Each of these units incorporates unique design features. Antelope Valley Unit 2 is the first multi-module SDA system designed for 18°F approach to saturation temperature operation. Durnrohr Unit 1 employs one-field ESP's for precollection of fly ash and four-field ESP's for final dust removal. Springerville Unit 1 is designed to operate at 18°F approach to saturation temperature out of the SDA with reheat prior to the reverse air bag filter. System descriptions and results from testing of these units are presented. Start-up problems are reviewed and solutions discussed. Operation and availability data of earlier started up units are updated.

43220 (EPRI-CS—5167-Vol.2, pp 9.69-9.84) **Status of calcium-based dry sorbent injection SO_2 control.** Rhudy, R.; McElroy, M.; Offen, G. May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920405. (CONF-861132—Vol.2).

From 10. symposium on flue gas desulfurization; Atlanta, GA, USA (18 Nov 1986).

The various processes that use dry, calcium-based sorbent injection for SO_2 control are described and their current status reviewed. There are five basic processes: two associated with the furnace - Furnace Sorbent Injection (FSI) and convective pass injection; and three associated with injection into the ductwork downstream of the air heater - in-duct dry injection, in-duct spray drying, and Hybrid Pollution Abatement System (HYPAS). Combinations of these processes are also possible.

43221 (EPRI-CS—5167-Vol.2, pp 9.85-9.106) **Pilot-scale studies of SO_2 removal by the addition of calcium-based sorbents upstream of a particulate control device.** Blythe, G.; Bland, V.; Martin, C.; McElroy, M.; Rhudy, R. May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920405. (CONF-861132—Vol.2).

From 10. symposium on flue gas desulfurization; Atlanta, GA, USA (18 Nov 1986).

EPRI is developing potentially low cost FGD retrofit technologies that involve the addition of calcium-based reagents to humidified flue gas just upstream of a particulate control device. Pilot-scale tests have been conducted with both fabric filter and ESP particulate collection devices. Two methods of reagent addition have been investigated: flue gas humidification with separate dry injection of sorbents, and in-duct spray drying where a lime-based slurry is sprayed directly into hot (300°F) flue gas. Results are presented which show the SO_2 removal potential for dry sorbent injection for both particulate collector types, and for in-duct spray drying upstream of the ESP. Also presented are the effects of a number of operating variables including approach to adiabatic saturation, calcium-to-sulfur molar ratio, solids recycle, reagent type, performance additives, and steam/sorbent coinjection. Finally, results are presented which indicate the effects of these sorbent injection processes on particulate collection efficiency. Results presented show that when humidifying the flue gas to within a 20°F approach to adiabatic saturation, conventional hydrated lime injected upstream of a fabric filter at a 2:1 Ca/S ratio can achieve 50 to 55% SO_2 removal. Coinjection of steam with the lime increased the SO_2 removal to nearly 70%. For injection of hydrated lime upstream of an ESP, SO_2 removal at a 20°F approach to adiabatic saturation and a 2:1 Ca/S ratio was 30 to 35%. Steam coinjection increased SO_2 removal to 40 to 45%. In-duct spray drying upstream of an ESP achieved 50% SO_2 removal at a 60°F approach to adiabatic saturation and a 1.6:1 Ca/S ratio.

43222 (EPRI-CS—5167-Vol.2, pp 9.107-9.123) **Current status of in-duct scrubbing technology.** Murphy, K.R.; Samuel, E.A.; Pennline, H.W. (General Electric Environmental Services, Inc., Lebanon, PA). May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920405. (CONF-861132—Vol.2).

From 10. symposium on flue gas desulfurization; Atlanta, GA, USA (18 Nov 1986).

The promulgation of revised stack height regulations and possible changes under consideration in the National Ambient Air Quality Standards could require older power plants to develop new compliance strategies and upgrade emission control systems. In such situations, a low cost, moderate removal efficiency, flue gas desulfurization technology could maintain the cost effectiveness of these plants. Such a technology was selected by the Department of Energy for demonstration in its Acid Rain Precursor Control Technology Initiative. The process, identified as In-Duct Scrubbing (IDS) applies the rotary atomizer techniques developed for lime based spray dryer FGD while utilizing existing flue gas ductwork and particulate collectors. In-Duct Scrubbing technology is anticipated to result in a dry desulfurization process of moderate removal efficiency (50%) for high sulfur coal-fired boilers. The critical elements for successful application are (1) adequate mixing for efficient reaction contact, (2) sufficient residence time to produce a non-wetting product, and (3) appropriate ductwork cross sectional area to prevent deposition of wet reaction products before particle drying is complete. The ductwork in many older power plants, previously modified to meet 1970 Clean Air Act requirements for particulate control, usually meets these criteria. The IDS technology and the status of the jointly sponsored In-Duct Scrubbing Pilot Study which is to be tested on the American Electric Power system are discussed.

43223 (EPRI-CS—5167-Vol.2, pp 9.125-9.146) **Development and pilot plant evaluation of silica-enhanced lime sorvents for dry flue gas desulfurization.** Jozewicz, W.; Jorgensen, C.; Chang, J.C.S.; Sedman, C.B.; Brna, T.G. (Acurex Corp., Research Triangle Park, NC). May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920405. (CONF-861132—Vol.2).

From 10. symposium on flue gas desulfurization; Atlanta, GA, USA (18 Nov 1986).

EPA's efforts to develop low cost, retrofittable flue gas cleaning technology include the development of highly reactive sorbents. Recent work addressing lime enhancement and testing at the bench-scale followed by evaluation of the more promising sorbents in a pilot-plant are discussed here. The conversion of $Ca(OH)_2$ with SO_2 increased several-fold compared with $Ca(OH)_2$ alone when $Ca(OH)_2$ was slurried with flyash first and later exposed to SO_2 in a laboratory packed bed reactor. $Ca(OH)_2$ enhancement increased with the increased flyash amount. Diatomaceous earths were very effective reactivity promoters of lime-based sorbents. Differential scanning calorimetry of the promoted sorbents revealed the formation of a new phase (calcium silicate hydrates) after hydration, which may be the basis for the observed improved SO_2 capture. Flyash/lime and diatomaceous earth/lime sorbents were tested in a 100 m^3/h (58 cfm) pilot facility incorporating a gas humidifier, a sorbent duct injection system, and a baghouse. The inlet SO_2 concentration range was 1000-2500 ppm. With once-through dry sorbent injection into the humidified flue gas [approach to saturation 10-20°C (18-36°F) in the baghouse], the total SO_2 removal ranged from 50 to 90% for a stoichiometric ratio of 1 to 2. Recycling the collected solids resulted in a total lime utilization exceeding 80 to 90%. Increased lime enhancement was also investigated by the use of additives.

43224 (EPRI-CS—5167-Vol.2, pp 9.147-9.162) **Dry/semi-dry flue gas desulfurization using the Lurgi circulating fluid bed absorption process.** Graf, R.; Riley, J.D. (Lurgi GmbH, Frankfurt, West Germany). May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920405. (CONF-861132—Vol.2).

From 10. symposium on flue gas desulfurization; Atlanta, GA, USA (18 Nov 1986).

The dry/semi-dry process, the Circulating Fluid Bed Absorption, is presented with its main characteristics and process features. This process is similar to the FGD with the well-known spray dryer but has some additional advantages. For example: slurry atomizer is not necessary, higher solid residence time in the absorber, higher mass transfer rate between SO_2 gas and lime feed, capable of reducing any SO_2 levels resulting from coals even with very high sulfur content to legislated levels, and the selection of a deduster type (baghouse or ESP) can be made independent of any stipulated desulfurization rate. Information on the planning, erection and operation of the first four contracted units, particularly of the first dry FGD plant which has been in operation since November 1984, is presented. The disposal routes available to this process

43225 (EPRI-CS—5167-Vol.2, pp 10.1-10.19) **Engineering and design aspects: disposal and by-product utilization of FGD residues.** Goodwin, R.W. (Environmental Consultants Associates, Upper Saddle River, NJ). May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920405. (CONF-861132—Vol.2).

From 10. symposium on flue gas desulfurization; Atlanta, GA, USA (18 Nov 1986).

The theory and application of engineering and managing systems designed to dispose and/or recover residues from wet lime and limestone-based FGD systems are presented. The work described is based up investigations conducted on pilot and operating FGD systems. The treatment of FGD sludge involves both primary and secondary dewatering, i.e., thickening/settling and filtration or centrifugation. Selection and sizing of such equipment depends upon the physical characteristics of the incoming FGD slurry. Of primary importance is the particle size and distribution. From a disposal consideration, achieving maximum dewatering is important to avoid thixotropic conditions during transport. Even when blended with fly ash, the resultant mixture may be thixotropic due to inadequate solids content; this is particularly true for thiosorbic lime sludges. Wall-board manufacturers require a 90+% solids content in the oxidized sludge product. Achieving such a high degree of dewatering requires attaining both large, i.e., > 50 μm particle size, and a normalized distribution. A practical mathematical and graphical concept to predict the resultant in-situ geotechnical properties for both oxidized and blended FGD sludge is presented. The particle size and SO_4/SO_3 ratio are correlated to strength and permeability. Operational considerations for systems designed to dispose and to utilize FGD residues are discussed. A simple technique to monitor the degree of oxidation is described which has been incorporated into several utility operating procedures.

43226 (EPRI-CS—5167-Vol.2, pp 10.21-10.40) **Effect of wet lime FGD operating conditions on improving particle size and and dewatering of sludge.** Baczek, F.; Benson, L.B.; Golightley, R.M.; Wilhelm, J. (EIMCO, Process Equipment Co., Salt Lake City, UT). May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920405. (CONF-861132—Vol.2).

From 10. symposium on flue gas desulfurization; Atlanta, GA, USA (18 Nov 1986).

Lime is used extensively as reagent in high-sulfur wet FGD systems. Magnesium-enhanced lime gives superior performance in scrubbing SO_2 from high-sulfur flue gases but sometimes results in sludge which is difficult to dewater. Recent field tests on full-scale wet lime FGD systems and other work suggest that FGD operating conditions in addition to liquor chemistry can cause improvement or deterioration of sludge solids particle size and dewatering. Lower slurry solids concentration and shorted residence time in the scrubber recycle tank where crystallization takes place produced larger sludge particles. An improvement in thickener performance resulted when larger particles were produced. Observations of the effect of scrubber operating conditions, including slurry solids concentration and liquor chemical composition, on sludge particle size and thickener performance in two full-scale wet magnesium-enhanced lime FGD systems are presented. Laboratory data are also presented which relates thickener capacity, filtration rates, filter cake solids and slurry viscosity to particles size for three magnesium-enhanced lime sludges. Included in a discussion of factors that affect FGD crystallization that relate to these observations.

43227 (EPRI-CS—5167-Vol.2, pp 10.41-10.59) **Design considerations for FGD solids disposal/utilization at a power plant with limited space.** Hengel, J.A.; Chapman, R.G.; Wilterdink, D.W. (Black & Veatch, Kansas City, MO). May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920405. (CONF-861132—Vol.2).

From 10. symposium on flue gas desulfurization; Atlanta, GA, USA (18 Nov 1986).

The problem of FGD solids disposal at Grand Haven's J.B. Sims Unit 3 is discussed. The disposal/utilization options considered and decisions made during the initial design stages are also discussed. Byproduct disposal options included trucking fly ash and scrubber solids to an offsite landfill, use of fly ash for roadbase material, and use of scrubber solids for wallboard manufacturing. Uncertain market conditions for these byproducts required that the new unit design include provisions to use all of these options. A summary is presented of the design development and the current operating practices, which include the production and sale of wallboard quality gypsum as a byproduct of the SO_2 removal process.

43228 (EPRI-CS—5167-Vol.2, pp 10.59-10.77) **Evaluation of washing alternatives for FGD byproduct gypsum production.** Colley, J.D.; Gray, S.M.; Stewart, D.A.; Wilhelm, J.A. (Radian Corp., Austin, TX). May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920405. (CONF-861132—Vol.2).

From 10. symposium on flue gas desulfurization; Atlanta, GA, USA (18 Nov 1986).

The results of an economic and technical evaluation of four commercially available alternatives for washing gypsum produced from flue gas desulfurization are presented. Two types of vacuum filtration are were evaluated - horizontal belt and rotary drum. A horizontal solid bowl continuous feed centrifuge and a vertical bowl batch feed centrifuge were tested also. The pilot-scale dewatering devices were fed thickener underflow from the martin Lake Generating Station FGD system. The scrubbers at Martin Lake are forced oxidized and routinely produce wallboard quality gypsum. Chloride was spiked into the thickener underflow slurry prior to being fed to the dewatering machines to determine the washing efficiency of each. Test variables included wash rate, chloride concentration, cake thickness, and throughput for the filters. In addition to these variables, RPM was also examined for the centrifuges. Samples of the product were analyzed for chloride to measure the wash efficiency for each set of conditions. An economic evaluation based on the results of the testing was completed. The economic study compares the capital and operating costs for three different types of dewatering systems for producing wallboard quality gypsum-horizontal filter, rotary filter, and vertical bowl centrifuge. The equipment is sized to handle material from a 500 MW unit firing a high sulfur bituminous coal.

43229 (EPRI-CS—5167-Vol.2, pp 10.79-10.100) **Design of waste management systems for calcium spray dryer FGD technology.** Klimek, A.P.; Eklund, A.G.; Dawson, G.W.; Golden, D.M. (Baker/TSA, Inc., Beaver, PA). May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920405. (CONF-861132—Vol.2).

From 10. symposium on flue gas desulfurization; Atlanta, GA, USA (18 Nov 1986).

Calcium spray dryer FGD technology is a viable SO_2 control technology available to the electric utility industry. This technology currently is utilized at utility generating stations burning lignite or low-sulfur subbituminous coal. Information concerning the waste and waste management systems associated with this technology is presented. Information concerning waste properties, waste management systems at stations currently using, or planning to use this technology, and a brief assessment of the federal, state, and local regulations that control the management and disposal of these wastes is presented. A typical waste management system for full size generating station using calcium spray dryer technology is then described. This system was developed based on typical waste properties, experience at other stations, and regulatory requirements. This information will provide guidance and assist utilities in assessing the operational and economic impacts of waste management when considering calcium spray dryer FGD technology.

43230 (EPRI-CS—5167-Vol.2, pp 10.101-10.121) **Influence of particulate control on waste management: integrated environmental control pilot plant results.** Cichanowicz, J.E.; Maroney, P.M.; Davidson, S.A. May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920405. (CONF-861132—Vol.2).

From 10. symposium on flue gas desulfurization; Atlanta, GA, USA (18 Nov 1986).

Results with the EPRI 2.5 MW(e) Integrated Environmental Control Pilot Plant (IECPP) compare the influence of particulate penetration on scrubber waste production and properties. Tests compared a fabric filter/wet scrubber and ESP/wet scrubber, the latter operated to simulate 1979 NSPS, 1971 NSPS, and pre-NSPS units. Tests were conducted with low sulfur coal at 400 ppm; flue gas spiking could be used to increase SO_2 to 2000 ppm. Scrubber

waste was dewatered in a thickener and vacuum belt filter (to 55% solids content), and fixed with fly ash. Results show scrubbers retrofit to pre-NSPS ESPs and forced to operate in zero-discharge could experience solid waste handling problems and increase operating costs. Specifically, particulate penetration above 0.10 lbs/MBtu can (a) reduce reagent utilization to 80%, causing waste handling/reliability problems, (b) increase solid waste production, and (c) reduce SO_2 removal. These results are attributable to inhibited limestone dissolution from an aluminum/fluoride compound. For both low sulfur and simulated high sulfur test conditions, allowing waste water discharge to purge aluminum/fluoride content restored performance to design levels. Particulate control efficiency also affected solid waste physical properties. The fabric filter/wet scrubber produced the lowest solid waste permeability (10^{-8} cm/sec). ESP operation at 1979 NSPS and pre-1971 NSPS ESPs increased solid waste permeability to 10^{-7} and 10^{-6} cm/sec, respectively. These results are most significant for scrubber retrofit to units with pre-NSPS ESPs. High sulfur coal scrubbers could be affected depending on water cycles of concentration and accumulation of aluminum/fluoride compounds. This problem could become significant with the increasing trend to restricted water discharge.

43231 (PB—87-195434/XAB) Characterization of individual fly-ash particles emitted from coal- and oil-fired power plants. Mamane, Y.; Miller, J.L.; Dzubay, T.G. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). 1986. 13p. (EPA—600/J-86/358). NTIS, PC A02/MF A01.

Pub. in Atmospheric Environment, Vol. 20, No. 11, 2125-2135(1986).

Individual particles from coal- and oil-fired power plants were analyzed by a scanning electron microscope equipped with an energy dispersive x-ray spectrometer to investigate the morphology and composition as a function of size. Samples were collected on filters by a dichotomous sampler in the fine (<2.5 micrometer aerodynamic diameter) and the coarse fractions (2.5 to 5-10 micrometers). In both fractions, coal fly-ash particles were predominantly smooth spheres, and no cenospheres (perforated hollow spheres) were detected. Almost 90% of the mass concentration occurred in the coarse fraction; the major elements included Al, Si, K, Ca, Ti, and Fe. Sulfur appeared as a surface layer on the mineral core. The abundances of Fe and S in each particle were highly variable. The ratio of Al to Si was fairly constant for most of the spheres but not for the relatively few Fe-rich or non-spherical coal fly ash particles. Over 90% of the mass of oil fly-ash occurred in the fine fraction.

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REFER ALSO TO CITATION(S) 44387

43232 (DOE/OR/21468—T1) Adaptive distribution system protection: Final report. Shan, K.R. (Shah and Associates, Inc., Gaithersburg, MD (USA)). 15 Jun 1987. Contract AC05-85OR21468. 130p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87013406.

This report presents concepts, functions, and organizations of adaptive distribution system protection (ADSP) schemes. ADSP constantly monitors real time data, update relay characteristics and upper and lower bounds of control functions when required, and analyzes them to provide faster and more sensitive protection of all distribution system components and optimized control of loads, capacitors and reclosing sequence of circuit breakers and reclosers. Three proposed ADSP systems, Computer Overcurrent Relaying (COR) System, Directional Comparison Relaying (DCR) System and Differential Protective Coordination System, are discussed in detail. Evaluation of these three systems using technical, non-technical and economic parameters has led to the selection of the COR system as the most promising ADSP scheme for the following reasons: (1) it is simple to implement, (2) it uses the same protection philosophy and components currently being used by the electric utility industry and (3) it has a high-benefit-to-cost ratio. This report outlines strategies of integrating ADSP schemes into existing electric utility distribution systems. 21 refs., 19 figs., 6 tabs.

43233 (EPRI-EL—5331) Series connection of gate-turnoff thyristors: Final report. McMurray, W. (General Electric Co., Schenectady, NY (USA). Corporate Research and Development Center; Electric Power Research Inst., Palo Alto, CA (USA)). Aug 1987. 105p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920550.

A particular snubber circuit configuration is proposed for use with high-voltage strings of gate-turnoff thyristors (GTOs). The interaction between GTO devices and this snubber is studied by means of the circuit simulator program SPICE. A SPICE subcircuit based on the "J3 Model" is employed to represent a GTO or ordinary thyristor. The mathematical behavior of the model is analyzed in some detail, leading to procedures for estimating the SPICE model parameters of a GTO. The snubber components are included in another subcircuit, which mimics the modular construction of actual equipment. The two subcircuits are incorporated in equivalent circuits for one or more phase legs of a voltage-source or current-source converter. A special equivalent circuit technique is used for simulation of series strings of many GTO devices with their snubbers. In particular, the series operation of mismatched devices is studied. A series of SPICE simulations illustrate the transient interaction between commutating legs of current-source or voltage-source converters, including both self-commutated and externally commutated modes of operation. The results confirm the success of the snubber arrangement and verify that the method of SPICE simulation can produce useful data for the development of high-voltage strings of GTOs. 26 refs., 41 figs.

43234 (EPRI-EL—5332) Feasibility of gate-turnoff thyristors in a high-voltage direct-current transmission system: Final report. McMurray, W. (General Electric Co., Malvern, PA (USA). Power Systems Management Business Dept.; General Electric Co., Schenectady, NY (USA). Corporate Research and Development Dept.; Electric Power Research Inst., Palo Alto, CA (USA)). Aug 1987. 84p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920545.

This study to identify potentially attractive applications for gate-turnoff thyristor (GTO) converters in utility systems includes both high-voltage direct-current (HVDC) valves and static volt-ampere reactive (VAR) controllers. The work includes a broad review of basic principles and the power circuit arrangements that are judged to be most attractive. The major differences between ordinary thyristors and GTO converters are discussed, including alternative HVDC transmission systems and static VAR controllers that are possible with GTOs. Whereas a current-source type of converter is the obvious choice with ordinary thyristors, the use of GTOs allows either current-source or voltage-source converters to be considered. A computer-aided analysis of the basic 6-pulse GTO current-source converter system is presented, including general equations for steady-state operation and plotting calculated waveforms. An analysis of a GTO voltage-source converter is given in less detail. Due to incomplete performance data, unresolved critical problems such as protection, and the disadvantages of higher cost, complexity and losses, it is difficult to recommend a specific GTO converter system at this time. The major advantage that GTO converters can offer is rapid and smoothly continuous control of reactive power. Further development of GTO converters should be aimed towards an application where reactive power control is very important and not readily achievable by conventional methods. 12 refs., 47 figs.

43235 (GEPP-TIS—963A) Recovery of vacuum gaps after arcing. Miller, H.C. (General Electric Co., Largo, FL (USA). Neutron Devices Dept.). 11 Jun 1987. Contract AC04-76DP00656. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013852.

This paper reviews the recovery of vacuum gaps: i.e., the return of the voltage holdoff capability of a vacuum gap after it has ceased to sustain a vacuum arc. After a brief description of vacuum arcs, the paper discusses cathode and anode arc phenomena as they affect recovery. Finally, various experimental results pertinent to recovery are presented and discussed. During conduction a vacuum gap contains electrons, ions, neutral atoms (vapor), and macroparti-

cles of electrode material. At current zero the production of electrons, ions, and macroparticles ceases immediately. If an anode spot is present it will take tens of microseconds to milliseconds for significant production of neutral vapor to cease; the time depending upon the rate at which the anode spot cools, which in turn depends upon the anode material and upon the size and depth of the anode spot at current zero. Early recovery is controlled by ions, later recovery by neutral atoms. The ultimate recovery voltage is a function of electrode surface properties. Magnetic fields may be used to promote recovery by helping to clear the vacuum gap of ions and electrons and by preventing the formation of anode spots or moving them before current zero. The most important requirement in obtaining the fastest recovery times is to design the vacuum gap to avoid the formation of anode spots, thus insuring that only cathode recovery phenomena are significant. 60 refs., 6 figs., 5 tabs.

43236 **(N—87-22004) EMC and power quality standards for 20-kHz power distribution.** Hansen, I.G. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1987. 8p. (CONF-870804—24; NASA-TM—89925; E—3626; NAS—1.15:89925; AIAA—87-9355). NTIS, PC A02/MF A01.

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

The Space Station Power Distribution System has been baselined as a sinusoidal single phase, 440 VRMS system. This system has certain unique characteristics directly affecting its application. In particular, existing systematic description and control documents were modified to reflect the high operating frequency. This paper will discuss amendments made on Mil STD 704 (Electrical Power Characteristics), and Mil STD 461-B (Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference). In some cases these amendments reflect changes of several orders of magnitude. Implications and impacts of these changes are discussed.

43237 **(ORNL/M—379) Report brief[s]: Electric energy systems, July 1987.** (Oak Ridge National Lab., TN (USA)). Jul 1987. Contract AC05-84OR21400. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013129.

A series of report briefs are presented in the field of electric power systems. These briefs are composed of short research summaries dealing with the control and operation of wind arrays in utility systems; fault current limiters for generator bus protection; solid dielectric and synthetic laminar cable insulations; the impact of the steep-front, short duration impulse on electric power system insulation; and the impact of high altitude electromagnetic pulse on electric power systems. (DWL)

21 NUCLEAR POWER PLANTS

REFER ALSO TO CITATION(S) 43206, 44808

43238 **(NUREG—0327-Rev.4) Owners of nuclear power plants: Percentage ownership of commercial nuclear power plants by utility companies.** Wood, R.S. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Aug 1987. 35p. NTIS, PC A03/MF A01 - GPO. File Number TI87900926.

The following list indicates percentage ownership of commercial nuclear power plants by utility companies as of June 1, 1987. The list includes all plants licensed to operate, under construction, docked for NRC safety and environmental reviews, or under NRC antitrust review. It does not include those plants announced but not yet under review or those plants formally canceled. In many cases, ownership may be in the process of changing as a result of altered financial conditions, changed power needs, and other reasons. However, this list reflects only those ownership percentages of which the NRC has been formally notified. Part I lists plants alphabetically with their associated applicants/licensees and percentage ownership. Part II lists applicants/licensees alphabetically with their associated plants and percentage ownership. Part I also indicates which plants have received operating licenses (OL's). Footnotes for both parts appear at the end of this document.

43239 **(NUREG/CR—4640) Handbook of software quality assurance techniques applicable to the nuclear industry.** Bryant, J.L.; Wilburn, N.P. (Pacific Northwest Lab., Richland, WA (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Licensee Performance and Quality Evaluation). Aug 1987. Contract AC06-76RL01830. 111p. (PNL—5784). NTIS, PC A06/MF A01 - GPO. File Number TI87014052.

Pacific Northwest Laboratory is conducting a research project to recommend good engineering practices in the application of 10 CFR 50, Appendix B requirements to assure quality in the development and use of computer software for the design and operation of nuclear power plants for NRC and industry. This handbook defines the content of a software quality assurance program by enumerating the techniques applicable. Definitions, descriptions, and references where further information may be obtained are provided for each topic.

2101 Power Reactors, Non-breeding, Light-water Moderated, Boiling Water Cooled

REFER ALSO TO CITATION(S) 43041, 43316, 43341, 43344, 43345, 43347, 43352, 43353, 43354, 43362, 43363, 43364, 43718, 43719, 43720, 43721

43240 **(EGG-RTH—7651) ATHENA [Advanced Thermal Hydraulic Energy Network Analyzer] solutions to developmental assessment problems.** Carlson, K.E.; Ransom, V.H.; Roth, P.A. (EG and G Idaho, Inc., Idaho Falls (USA)). Mar 1987. Contract AC07-76ID01570. 128p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87012424.

The ATHENA (Advanced Thermal Hydraulic Energy Network Analyzer) code has been developed to perform transient simulation of the thermal hydraulic systems that may be found in fusion reactors, space reactors, and other advanced systems. As an assessment of current capability the code was applied to a number of physical problems, both conceptual and actual experiments. Results indicate that the numerical solution to the basic conservation equations is technically sound, and that generally good agreement can be obtained when modeling relevant hydrodynamic experiments. The assessment also demonstrates basic fusion system modeling capability and verifies compatibility of the code with both CDC and CRAY mainframes. Areas where improvements could be made include constitutive modeling, which describes the interfacial exchange term. 13 refs., 84 figs.

43241 **(EPRI-NP—5364M) Environmental effects on intergranular stress corrosion cracking (GSCC) of sensitized stainless steel in high-temperature solutions: Final report.** Cragnolino, G.; Szklarska-Smialowska, Z.; Christman, T.; Eghan, A.K.; Govindarajan, S.; Lee, J.K.; Shim, S.H. (Ohio State Univ., Columbus (USA). Dept. of Metallurgical Engineering; Electric Power Research Inst., Palo Alto, CA (USA)). Aug 1987. 78p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920553.

The effect of relevant environmental variables on the IGSCC of furnace sensitized AISI 304 stainless steel in dilute aqueous solutions has been studied at temperatures ranging from 100 to 275°C using the slow strain rate technique. The significance of a critical potential above which IGSCC occurs (E/sub ISCC/) has been discussed on the basis of literature data for both the current normal operating BWR environment and that modified by the injection of hydrogen. The effect of pH on E/sub ISCC/ in solutions containing Na_2SO_4 and H_2SO_4 has been determined, as well as the effect on the IGSCC behavior of aqueous impurities such as chloride and sulfide, thiosulfate, cupric and lead ions. In addition, the role of low molecular weight carboxylic acids, such as formic, acetic and oxalic, has been evaluated in water over a wide range of dissolved oxygen concentrations. Finally, the effect of fluid flow velocity on the IGSCC has been studied using slow strain rate rests and ac impedance methods to determine the influence of oxide film properties on the initiation of intergranular cracks under various flowing conditions.

43242 **(INIS-mf—10643) Thermohydraulic investigations for PWR and BWR type reactors.** Brayner de Oliveira Lira, C.A. (Hannover Univ. (Germany, F.R.). Fakultaet fuer Maschinenwesen). 14 Dec 1984. 132p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE87752446.

A model calculation is developed in this work, in order to make the design, optimisation and improvement of systems possible, which work in light water reactor conditions. Differing from the usual solutions, the computer program has a double task. First, the whole plant is simulated, in order to determine the flow, temperature and pressure at various planes of measurement, which is called circuit simulation in this work. The individual components are also taken into account, i.e. it is possible to describe the water level in the condenser, the steam content of the test section etc. precisely. Some measurements on the IPEN water circuit were used for comparison and for the assessment of the theoretical model for calculations. These measurements were done in various thermo-hydraulic conditions and in as diverse circuit configurations as possible. There is good agreement between calculation and measurement, but the small deviations depend on the configuration used and the measuring position. Temperature measurements in a fixed configuration give good repeatability and also show good agreement with the calculations. One should note the short calculation time, which is due to the process of calculation developed. The disadvantage of the modular process is that the calculation of a component depends greatly on its internal construction. It is, however, possible to achieve wide applicability by the flexible input data representation. The applicability for other systems was confirmed by calculation of the FRoeJA experiments and the bundle of a commercial nuclear powerstation and by comparison with the wellknown COBRA IV-1 computer model.

43243 **(JAERI-M—87-003) Structural analysis of a Japanese BWR MARK-I containment under internal pressure loading.** Isozaki, Toshikuni; Hashimoto, Wataru. (Japan Atomic Energy Research Inst., Tokyo). Feb 1987. 94p. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. File Number DE87752988.

As one of the severe accident research programs, elastic-plastic structural analysis concerning the MARK-I steel containment was carried out using the general purpose finite element code ADINA. The analysis revealed that the containment vessel began to yield at the nuckle at 1.70 MPa and that it began to contact at the cylindrical part with the biological shield wall at 1.98 MPa.

43244 (JAERI-M—87-025, pp 155-173) **Sensitivity analysis of HCLWR.** Takeda, Toshikazu. (Osaka Univ., Suita, Japan. Faculty of Engineering). Feb 1987. NTIS (US Sales Only), PC A16/MF A01. File Number DE87900676. (NEANDC(J)—123/U; INDC(JPN)—109/L; CONF-8611159—).

From Seminar on nuclear data; Tokai, Japan (26 Nov 1986).

The sensitivity coefficients of neutronic performance parameters in high-conversion LWR cells have been calculate by means of the SAINT code. The difference between sensitivities was investigated for cells with different moderator to fuel volume ratios and different Pu enrichment. The burnup dependence of the sensitivities was also discussed with an emphasis on the effect of fission products on the cell parameters. We have performed the sensitivity analysis for the PROTEUS core. The effect of the difference between the group cross sections obtained by SRAC code from JENDL-2 and ENDF/B-IV on the cell parameters k/sub eff/, reaction rate ratio and coolant void worth was estimated by considering the cross section changes in the resolved and unresolved resonances of main heavy nuclides, separately. This work was performed as the activity of Working Group on Integral Test for JENDL in JNDC.

43245 **(JAERI-M—87-049) Data list of nuclear power plants in Japan. BWR edition (1987).** Izumi, Fumio; Ito, Noboru; Higuchi, Suminori; Kobayashi, Kensuke; Tobioka, Toshiaki. (Japan Atomic Energy Research Inst., Tokyo). Mar 1987. 329p. (In Japanese). NTIS (US Sales Only), PC A15/MF A01. File Number DE87752993.

The PPD (Nuclear Power Plant Data Base) has been under development in JAERI since 1983 as a six-year program to provide useful information for reactor safety regulation and reactor safety research. Information source of the PPD is mainly based on SAR's (Safety Analysis Reports) of 35 nuclear power plants which are operating, under construction or under licensing review in Japan. The report BWR edition consists of several data lists stored in the PPD, concerning safety design such as performances, equipments and installations of 18 BWR plants in Japan. The informations are based on SAR Attachment Chapter 8 "Nuclear Reactor Facility Safety Design".

43246 **(NUREG—1253) Technical specifications, Nine Mile Point Nuclear Station, Unit No. 2 (Docket No. 50-410): Appendix "A" to License No. NPF-69.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Jul 1987. 525p. NTIS, PC A22/MF A01. File Number TI87900882.

This report presents specifications for the Nine Mile Point Nuclear Station, Unit No. 2 concerning: safety limits, and limiting safety system settings; limiting conditions for operation and surveillance requirements; design features; and administrative controls. (FI)

43247 **(NUREG/CR—4731-Vol.1) Residual life assessment of major light water reactor components: Overview: Volume 1.** Cloud, R.L.; Cook, J.F.; Daye, M.A.; Hopkins, W.G.; House, L.J.; Malhotra, V.; Mantle, H.; Mikesell, W.R.; Odette, G.R.; Ritchie, R.O. (EG and G Idaho, Inc., Idaho Falls (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering Technology). Jun 1987. Contract AC07-76ID01570. 196p. (EGG—2469-Vol.1). NTIS, PC A09/MF A01 - GPO. File Number TI87013352.

This report presents an assessment of the aging (time-dependent degradation) of selected major light water reactor components and structures. The stressors, possible degradation sites and mechanisms, potential failure modes and currently used nondestructive examinations, in-service inspection (ISI) and life assessment methods are discussed for seven major light water reactor components: pressurized water reactor (PWR) and boiling water reactor (BWR) pressure vessels, PWR containment structures, PWR reactor coolant piping, PWR steam generators, BWR recirculation piping, and reactor pressure vessel supports. Unresolved technical issues related to life extension of these components, including requirements for advanced ISI and life assessment methods, are also discussed.

43248 **Regression model for Zircaloy cladding in-reactor creepdown: Database, development, and assessment.** Shah, V.N.; Tolli, J.E.; Lanning, D. (EG and G Idaho, Inc., Idaho Falls, USA; Battelle Pacific Northwest Labs., Richland, WA, USA). *Nuclear Engineering and Design;* **101**: No. 3, 233-247(May 1987). (CONF-850824—). Contract AC07-76ID01570.

From 5. international seminar on mathematical and mechanical modelling of reactor fuel elements; Harwell, Oxfordshire, UK (15 Aug 1985).

The paper presents a cladding deformation model developed to analyze cladding creepdown during steady state operation in a PWR and a BWR. This model accounts for variation in the Zircaloy cladding heat treatments - cold worked and stress relieved material typically used in a PWR and fully recrystallized material typically used in a BWR. This model calculates cladding creepdown as a function of hoop stress, fast neutron flux, exposure time, and temperature. The paper also presents a comparison between cladding creep calculations by the creepdown model and corresponding test results from the KWU/CE program. ORNL HOBBIE experiments, and EPRI/Westinghouse Engineering cooperative project. The comparisons show that the creepdown model calculates cladding creep strains reasonably well.

2102 Power Reactors, Non-breeding, Light-water Moderated, Non-boiling Water Cooled

REFER ALSO TO CITATION(S) 43041, 43240, 43242, 43244, 43247, 43248, 43280, 43314, 43316, 43341, 43343, 43344, 43346, 43347, 43348, 43355, 43356, 43357, 43359, 43362, 43364, 43365, 43366, 43718, 43719, 43720, 43721

43249 **(EPRI-NP—5234) PWR [pressurized water reactor] radiation fields, 1983-1985: Interim report.** Scaglia, L.A.; Bergmann, C.A. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Nuclear Technology Systems Div.; Electric Power Research Inst., Palo Alto, CA (USA)). Jul 1987. 363p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920513.

Data have been collected to characterize plant radiation fields as well as conducting research with the objective of reducing exposure rate buildup in PWR systems. The Standard Radiation Monitoring Program (SRMP) established a broad-based set of radiation field data that enables examination of the factors which influence the buildup of radiation fields in pressurized water reactors (PWRs). This second report presents the exposure rate trends observed in PWRs based on the SRMP data and evaluates the effect of various parameters in particular, primary coolant chemistry, on exposure rates.

43250 **(EPRI-NP—5249-Vol.3) Qualification of remedial methods to prevent primary-side stress corrosion cracking of steam generator tubing: Volume 3, Global heat treatment: Final report.** Frederick, G.; Hernalsteen, P.; Stubbe, J. (Belgatom S.A., Brussels (Belgium); Electric Power Research Inst., Palo Alto, CA (USA)). Jun 1987. 742p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920502.

Significant amounts of primary side cracking have occurred in the mechanically expanded area of the tubes of PWR steam generators in Europe, in Japan and to a lesser extent in the USA. A program was launched by the Belgium utilities and was further cosponsored by the Steam Generator Owners Group (SGOG)/Electric Power Research Institute (EPRI) to develop preventive actions applicable to both new and operating generators. These preventive measures include stress relaxation and metallurgical improvement of the material by an in situ heat treatment of the whole tubesheet. The global heat treatment qualification program is presented in this volume of the report.

43251 **(EPRI-NP—5265) Hideout of sodium salts in tubesheet crevices: Final report.** Brunet, J.P.; Campon, J.L. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France); Electric Power Research Inst., Palo Alto, CA (USA)). Jul 1987. 103p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920512.

The hideout of sodium hydroxide and sodium chloride in tubesheet crevices was studied in single tube model boilers at CADARACHE. Radioactive Na^{24} was used for the measurements. Crevices of 0.2 mm width were empty or packed. A hydraulically expanded crevice and a rolled crevice were also studied. The concentration rate depends on the bulk water concentration but the equilibrium concentration appears to be related only to thermal conditions. The equilibrium value of 25 moles per liter in the crevice was extrapolated, the sodium concentration in the bulk water being in the range of 5 to 50 ppM. This equilibrium will be obtained with an "integrated pollution" of 5000 to 10,000 ppM x hours. Flushing produced by the boiler depressurization was shown to be an effective way to remove salt from the crevice. Sodium hydroxide was shown to concentrate even in a residual crevice of few μm width.

43252 **(EPRI-NP—5329) Signal processing for coarse-grained materials: Interim report.** Selby, G.P.; Shankar, R.; Hunt, J.F. (Jones (J.A.) Applied Research Co., Charlotte, NC (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jul 1987. 37p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920531.

Reliable ultrasonic inspection of coarse-grained materials, such as cast stainless steel components in the primary piping loop of pressurized water reactors (PWRs) and dissimilar metal welds, has not been satisfactorily demonstrated to the utilities. The inspection for flaws is difficult because strong reflections from the grain boundaries could mask the flaw signal response: in addition, the ultrasonic beam can be redirected by the "wave guide" effect of the grain structure. This report discusses signal processing approaches that may be relevant to inspection of such materials. Specifically, spatial averaging - a proven technique for enhancing signals that exhibit spatial coherency - was found to be useful in enhancing signal-to-noise ratio (SNR) for flaws whose lengths were larger than the average grain size. Three specimens of PWR main coolant piping, each a cast steel elbow welded to forged steel containing fatigue flaws, were examined with a personal computer (PC)- based data acquisition and imaging system developed under EPRI funding. In addition, an axial flaw intentionally placed in the Inconel weld of a nozzle-to-safe-end mockup obtained from the canceled Phipps Bend plant was examined. The PC-based system was modified to include software capabilities to perform signal averaging and filtering. The images produced before and after signal processing showed improvements in flaw detectability.

43253 (IAEA-TECDOC—412, pp 27-43) **Thorium utilization in PWRs: status of work in the cooperative Brazilian/German program.** Peehs, M.; Schlosser, G.; Pinheiro, R.B.; Maly, V.; Hrovat, M. (Kraftwerk Union A.G., Erlangen, Germany, F.R.; Empresas Nucleares Brasileiras SA, Belo Horizonte; Kernforschungsanlage Juelich G.m.b.H., Germany, F.R.; Nuklear-Chemie und -Metallurgie G.m.b.H., NUKEM, Hanau, Germany, F.R.). Mar 1987. NTIS (US Sales Only), PC A08/MF A01. File Number DE87702566. (CONF-8512120—).

From International Atomic Energy Agency technical committee on utilization of thorium-based nuclear fuel: current status and perspectives; Vienna, Austria (2 Dec 1985).

The major results of the program "Th-Utilization in PWR's" are presented and discussed: The investigations show that the standard KWU-PWR can accommodate (Th,U)O/sub 2/ and (Th,Pu)O/sub 2/ fuel without changes in the fuel element design, in 3 and 4-batch operation scheme, without penalties in the reactor performance. An advanced fuel fabrication scheme using direct pelletizing methods out of ex-gel microspheres has been developed on laboratory scale. The (Th,U)O/sub 2/ test fuel produced satisfies PWR-specification and is currently undergoing irradiation testing. Thermal and mechanical design of fuel pins with thoria-based fuel is validated by the current instrumented single rod irradiation test. Cold laboratory investigations indicate that the (Th,U)O/sub 2/ PWR-fuel can be reprocessed using presently known technology, including the chop-leach technique and modified THOREX extraction process. 17 refs, 5 figs, 4 tabs.

43254 (IAEA-TECDOC—412, pp 45-58) **Thorium cycle in unmodified PWRs.** Gambier, G.; Schaeffer, H. (Electricite de France, 92 - Clamart. Direction des Etudes et Recherches). Mar 1987. NTIS (US Sales Only), PC A08/MF A01. File Number DE87702566. (CONF-8512120—).

From International Atomic Energy Agency technical committee on utilization of thorium-based nuclear fuel: current status and perspectives; Vienna, Austria (2 Dec 1985).

For more than ten years the Commissariat a l'Energie Atomique and the Electricite de France have jointly carried out experimental and design studies in different fields: HTRs, MSRs, PWRs. With regard to the PWRs, the studies first concerned the use of Plutonium with Thorium to start the cycle. A satisfactory solution has been obtained by recycling the Plutonium with Thorium as from the first core loading. The solution proposed consists of loading the whole reactor with Th-Pu assemblies from the first core and no longer using the standard checkerboard loading; the assemblies are loaded in rings. Two positive points appear: burnable poisons are no longer necessary and the assemblies are no longer divided into several zones (as with Plutonium recycle with Uranium in reloadings). There are two rather negative characteristics: the second generation Plutonium may be used only in FBRs and the conversion factor is rather small. Nevertheless the proposed solution gives acceptable pin power peak, temperature coefficients, etc... Satisfactory solutions have also been obtained for cores loaded with Th-U233 assemblies. The main problem is, in this case,

the moderator temperature coefficient. Different solutions may be found to solve this problem: we have chosen the one which gives simultaneously an acceptable moderator coefficient and a conversion factor improvement (the use of spectrum shift control). 10 refs, 11 figs, 3 tabs.

43255 (INIS-mf—10936, pp 102-112) **Contemporary state-of-the-art and production of Skoda steam turbines.** Drahny, J. (Skoda, Plzen, Czechoslovakia). 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702597. (CONF-8410470—Pt.1).

From 8. conference on steam turbines of large output; Karlovy Very, Czechoslovakia (30 Oct 1984).

50% of the production programme of steam turbines of the SKODA enterprise is designed for export. 50% of the annual production is made up of basic production line turbines, the rest are special purpose turbines. At present the principal type turbines include a 220 MW saturated steam turbine designed for nuclear power plants with WWER-440 reactors. After the year 1990 the main product will be a 1000 MW saturated steam turbine operating at 3000 RPM designed for pressurized water reactors. Three nuclear power plants will be operating 24 turbines with a unit power of 220 MW, all are designed for heat extraction for district heating purposes. Briefly presented is the programme of the research of steam turbines in Czechoslovakia, and the cooperation is outlined between SKODA and the French company Alsthom-Atlantique. (Z.M.).

43256 **(JAERI-M—87-050) Data list of nuclear power plants in Japan. PWR edition (1987).** Izumi, Fumio; Ito, Noboru; Higuchi, Suminori; Kobayashi, Kensuke; Tobioka, Toshiaki. (Japan Atomic Energy Research Inst., Tokyo). Mar 1987. 395p. (In Japanese). NTIS (US Sales Only), PC A17/MF A01. File Number DE87752997.

The PPD (Nuclear Power Plant Data Base) has been under development in JAERI since 1983 as a six-year program to provide useful information for reactor safety regulation and reactor safety research. Information source of the PPD is mainly based on SAR's (Safety Analysis Reports) of 35 nuclear power plants which are operating, under construction or under licensing review in Japan. The report PWR edition consists of several data lists stored in the PPD, concerning safety design such as performances, equipments and installations of 17 PWR plants in Japan. The informations are based on SAR Attachment Chapter 8 "Nuclear Reactor Facility Safety Design".

43257 **(NUREG—1276) Technical specifications, Braidwood Station Unit Nos. 1 and 2 (Docket Nos. STN 50-456 and STN 50-457): Appendix "A" to License No. NPF-72, [October 1986-July 1987].** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Jul 1987. 489p. NTIS, PC A21/MF A01 - GPO. File Number TI87900897.

The Braidwood Station, Units 1 and 2, technical specifications were prepared by the US Nuclear Regulatory Commission to set forth the limits, operating conditions, and other requirements applicable to a nuclear reactor facility as set forth in Section 50.36 of 10 CFR Part 50 for the protection of the health and safety of the public.

43258 **(NUREG—1279) Technical specifications, Beaver Valley Power Station, Unit 2 (Docket No. 50-412): Appendix "A" to License No. NPF-73.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Aug 1987. 423p. NTIS, PC A18/MF A01 - GPO. File Number TI87900957.

This report presents information concerning the Beaver Valley Power Station Unit 2 Reactor. Topics under discussion include: safety limits and limiting safety system settings; limiting condition for operation and surveillance requirements; design features; and administrative controls. (JDB)

43259 **(NUREG/CR—4850) Steam Generator Group Project: Task 10, Secondary side examination.** Schwenk, E.B. (Pacific Northwest Lab., Richland, WA (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering). Jun 1987. Contract AC06-76RL01830. 104p. (PNL—6045). NTIS, PC A06/MF A01 - GPO. File Number TI87013008.

This report concludes an effort to examine and assess from the secondary side, the condition of the retired-from-service Surry 2A steam generator. It is includes photographs of degradation of various components or regions in a generic recirculating type steam generator. The photographic detail given in the text (and the previous report NUREG/CR-3843, PNL-5033) have not been readily available to many investigators outside the Nuclear Steam Supply Vendors and Users. The photographs include views of Inconel 600 heat exchanger tubes (0.875 diameter [nominal] x 0.050 inch wall) showing deformed and intergranularly stress-corrosion cracked U-bends, tube denting in the support plate, intergranular attack and thinning (both in the tube sheet region), support plat deformation and cracking at flow slots and in ligaments between flow holes and tube holes. In addition, photographs of tube pitting, anti-vibration bar fretting, and the sludge pile are presented. An experimental stress analysis was conducted on a distorted Row 1 tube in the region of a compressed flow slot between the 6th and 7th (top) support plates. During removal of the tube, relaxation strains were measured and residual stresses calculated. Finally a cursory metallurgical failure analysis was conducted on a broken U-bend (R1C91) to determine its mode of failure. A rotabroach boring technique was used to make multiple penetrations with minimal damage to the secondary side, at various locations on the shell.

43260 **(VTT-TIED—605) Chemical methods for the use of niobium from pressure vessel cladding as a fast neutron dosimeter.** Karnani, H. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Aug 1986. 40p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87752414.

the steel samples from the cladding of a pressure vessel of an operating nuclear power reactor were obtained by scraping. The cladding material of the pressure vessel contained about 0.5 % niobium. It was desired to use the niobium as a dosimeter for estimating fast fluences at the pressure vessel. The weak radiation from the reaction product /sup 93m/Nb cannot be measured in the presence of other elements and interfering activities. A method was developed to separate niobium from other metals present; the concentration and yield of niobium were determined spectrophotometrically. The irradiated niobium was electrodeposited from aqueous solutions on copper discs. The amount of the deposited niobium was determined by a radiochemical method which makes use of its own radioactivity - measured with a liquid scintillation counter - and the known starting mass of niobium. It was possible to determine the deposited niobium masses (5 to 200 microgram) with a desired degree of accuracy. The absolute emission rate of X-rays could then be measured without any self-absorption or interference from other activities. The mass of niobium on each preparate and its X-ray emission rate, later on, were used as basic experimental data for the estimation of last neutron doses at the pressure vessel.

2103 Power Reactors, Non-breeding, Graphite Moderated

REFER ALSO TO CITATION(S) 43349, 43351, 43369, 43371, 43372, 43537, 43639

43261 **(GA-A—18857) Perspectives on deployment of modular high temperature gas-cooled power plants.** Northup, T.E.; Penfield, S. (GA Technologies, Inc., San Diego, CA (USA); Gas-Cooled Reactor Associates, San Diego, CA (USA)). Jul 1987. Contract AC03-84SF11963. 13p. (CONF-870863—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013451.

From Seminar on small and medium-sized nuclear reactors: safety and licensing issues; Lausanne, Switzerland (24 Aug 1987).

Energy needs and energy options are undergoing re-evaluation by almost every country of the world. Energy issues such as safety, public perceptions, load growth, air pollution, acid rain,

construction schedules, waste management, capital financing, project cancellations, and energy mix are but a few of those problems that are plaguing planners. This paper examines some of the key elements of the energy re-evaluation and transition that are in progress and the potential for the Modular High Temperature Gas-Cooled Reactor (Modular HTGR) to have a major impact on energy planning and its favorable prospects for deployment.

43262 **(GA-A—18878) Modular High-Temperature Gas-Cooled Reactor (MHTGR) status.** Breher, W.; Neylan, A.; Shenoy, A. (GA Technologies, Inc., San Diego, CA (USA)). May 1987. Contract AC03-84SF11963. 8p. (CONF-870804—21). NTIS, PC A02. File Number DE87012088.

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

The MHTGR is an advanced reactor concept being developed under a cooperative program involving the US government, the nuclear industry, and the utilities. The design utilizes basic HTGR features of ceramic fuel, helium coolant, and a graphite moderator. However, the specific size and configuration is selected to utilize the inherent safety characteristics associated with these standard features to develop passive safety systems that provide a significantly higher margin of safety and investment protection than current generation reactors. The design meets the Protective Action Guideline (PAG) limits at the 425 m site boundary, hence precluding the need for evacuation or sheltering of the public during any licensing basis event. The safe behavior is not dependent upon operator action and is insensitive to operator error. The conceptual design is presently being reviewed by the Nuclear Regulatory Commission (NRC). A safety evaluation report and licensability statement are scheduled to be issued by the NRC in January 1988. Status of the design with respect to applications, performance/operation, siting flexibility, investment protection, safety and economics are presented in this paper.

43263 **(JAERI-M—87-015) Nuclear characteristic study of the spherical fuel for HTGR with DELIGHT-6(Revised) code and SRAC code and comparison of their results.** Yamashita, Kiyonobu; Shindo, Ryuiti. (Japan Atomic Energy Research Inst., Tokyo). Mar 1987. 35p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. File Number DE87752976.

The nuclear characteristic study of spherial fuel was carried out with the one-dimensional lattice burnup code "DELIGHT-6 (Revised version)" for HTGR and with JAERI-Standard Reactor Analysis Code "SRAC". The items of the analyzed nuclear characteristics are (1) Infinite multiplication factors, (2) Burnup characteristics, (3) Fuel and modelator temperature effects on reactivity. A good agreement is shown in the comparison study for the results which are obtained from the both codes. It is concluded from this comparison study that the accuracy of both codes analyzing the spherical fuel are almost in same level.

43264 **(JAERI-M—87-016) Effect of irradiation temperature on irradiation-induced lattice parameter change in ThO/sub 2/-base fuels (JRR-2, VOF-18H capsule).** Akabori, Mitsuo; Itoh, Akinori; Shiratori, Tetsuo; Ikawa, Katsuichi; Shiba, Koreyuki. (Japan Atomic Energy Research Inst., Tokyo). Feb 1987. 22p. (In Japanese). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752998.

Effect of irradiation temperature on irradiation-induced lattice parameter changes in ThO/sub 2/-base fuels was investigated by an instrumented capsule irradiation at high temperatures (300 — 500 deg C). The lattice parameter growth in (Th,U)O/sub 2/ decreased with the increase of the irradiation temperature. The behavior of the postirradiation recovery suggested that the starting temperature of the recovery is made higher by the high temperature irradiation. Addition of CaO, Y/sub 2/O/sub 3/ and Nb/sub 2/O/sub 5/ in ThO/sub 2/ would enhance the irradiation recovery and the increase of the starting temperature. The effect of the irradiation temperature was also discussed by comparing with data for room temperature irradiation.

43265 **(JAERI-M—87-023) On the disintegration and acid leaching method for measuring free uranium in HTGR fuel compacts.** Kobayashi, Fumiaki; Fukuda, Kousaku. (Japan Atomic Energy Research Inst., Tokyo). Feb 1987. 14p. (In Japanese). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752974.

In order to improve the disintegration and acid leaching method for measuring free uranium in HTGR fuel compacts, a new apparatus was devised and several tests with regard to the acid leaching were made. The apparatus devised was such one which could disintegrate a fuel compact uniformly in nitric acid solution by rotating it. The optimum conditions of disintegration were 3 - 4 A of electric current and 20 h of leaching time in 7 mol/l concentration of the nitric acid solution. The apparatus operated under these conditions made it possible to disintegrate the compact much faster than the conventional method. For chemical analysis of uranium after the leaching, two methods, Arsenazo III and fluorophotometery were examined and the fluorophotometery which was easier way than the former, was found to be applicable for uranium analysis with 14 % of the standard deviation in the measured results. Also made was a study on the uranium contamination source in the fuel compacts, of which results indicated that the major sources were the failed coated particles and contamination during a compact fabrication process. Uranium contaminated in the latter source was inferred to be natural one.

43266 **(JAERI-M—87-024) Detection of failed and defective coating layers in HTGR fuel particles by methylene iodide intrusion.** Minato, Kazuo; Kikuchi, Hironobu; Fukuda, Kousaku. (Japan Atomic Energy Research Inst., Tokyo). Feb 1987. 22p. (In Japanese). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752990.

The technique of impregnation with liquid methylene iodide followed by X-ray radiograpy was tested to detect failed particles and defective pyrolytic carbon layers. The test revealed that this technique was useful and easier than the acid-leach method and the chlorine-leach method though this technique was not of wide application. This technique was then applied to examine 26 kinds of pyrolytic carbon layers with different deposition parameters. Some pyrolytic carbon layers were intruded by methylene iodide. The relation between the fraction of defective pyrolytic carbon layers and their deposition conditions was studied, and the fracture and outer surfaces of the layers were observed by scanning electron microscopy.

2105 Power Reactors, Breeding

REFER ALSO TO CITATION(S) 43322, 43323, 43337, 43339

43267 **(CEA-CONF—8793) Design target accuracies, data uncertainties and sensitivity studies.** Salvatores, M. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. des Reacteurs a Neutrons Rapides). Apr 1986. 115p. (CEA-DRNR-P—330; CONF-8604317—1). NTIS (US Sales Only), PC A06/MF A01. File Number DE87752221.

From Interregional training course on processing of nuclear data for nuclear reactor applications; Bombay, India (21 Apr 1986).

The aim of this course is to give an overview of the general problem of design parameter target accuracy assessment, the related data needs and the uncertainty analysis techniques which provide the tools for these studies. Concerning target accuracy assessment, this paper is essentially based on a paper, related to LMFBR's. Data needs will be illustrated by the example of fission data needs, in all the fields of core design and fuel cycle. Uncertainty analysis is a general notion which covers different fields. In this paper we will essentially describe the so-called data adjustment aspect. Finally, the sensitivity methods, based on perturbation theory will be described for different type of applications.

43268 **(CEA-CONF—8796) Sodium leak detection on large pipes. Heat insulating shells made of silico-aluminate.** Antonakas, D.; Blanc, R.; Casselman, C.; Malet, J.C. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. des Reacteurs a Neutrons Rapides). May 1986. 16p. (In French). (CEA-DRNR-P—335; CONF-860501—22). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752224.

From Conference on the science and technology of fast reactor safety; Channel Islands, UK (12 May 1986).

This report presents an equipment installed on the large secondary pipes of fast reactors, ensuring several functions: support and equilibrium of static and dynamic loads, heat insulator, preheating, and the detection of possible sodium leaks. The research programs associated to the development of the shells are briefly evoked; then, the report deals no longer with the studies on silico-aluminate aging and the detection performance.

43269 **(CONF-870418—8) LMR [liquid metal reactor] centrifugal pump coastdowns.** Dunn, F.E.; Malloy, D.J. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 10p. NTIS, PC A02. File Number DE87011530.

From Topical meeting on anticipated and abnormal transients in nuclear power plants; Atlanta, GA, USA (12 Apr 1987).

A centrifugal pump model which describes the interrelationships of the pump discharge flowrate, pump speed, shaft torque and dynamic head has been implemented based upon existing models. Specifically, the pump model is based upon the dimensionless-homologous pump theory of Wylie and Streeter. Given data from a representative pump, homologous theory allows one to predict the transient characteristics of similarly sized pumps. This homologous pump model has been implemented into both the one-dimensional SASSYS-1 systems analysis code and the three-dimensional COMMIX-1A code. Comparisons have been made both against other pump models (CRBR) and actual pump coastdown data (EBR-II and FFTF). Agreement with this homologous pump model has been excellent. Additionally, these comparisons indicate the validity of applying the medium size pump data of Wylie and Streeter to a range of typical LMR centrifugal pumps.

43270 **(CONF-870816—24) Experimental and analytical studies of passive shutdown heat removal systems.** Pedersen, D.; Tessier, J.; Heineman, J.; Stewart, R.; Anderson, T.; August, C.; Chawla, T.; Cheung, F.B.; Despe, O.; Haupt, H.J. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 15p. NTIS, PC A02/M A01; 1; GPO Dep. File Number DE87011459.

From 24. national heat transfer conference and exhibition; Pittsburgh, PA, USA (9 Aug 1987).

Using a naturally circulating air stream to remove shutdown decay heat from a nuclear reactor vessel is a key feature of advanced liquid metal reactor (LMR) concepts developed by potential vendors selected by the Department of Energy. General Electric and Rockwell International continue to develop innovative design concepts aimed at improving safety, lowering plant costs, simplifying plant operation, reducing construction times, and most of all, enhancing plant licensability. The reactor program at Argonne National Laboratory (ANL) provides technical support to both organizations. The method of shutdown heat removal proposed employs a totally passive cooling system that rejects heat from the reactor by radiation and natural convection to air. The system is inherently reliable since it is not subject failure modes associated with active decay cooling systems. The system is designed to assure adequate cooling of the reactor under abnormal operating conditions associated with loss of heat removal through other heat transport paths.

43271 **(FRA-TM—159) A technique for computing the reactivity feedback due to core-assembly bowing in LMFBR's.** Finck, P.J. (Argonne National Lab., IL (USA)). Jun 1987. Contract W-31109-ENG-38. 102p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87012660.

The usual neutronic approximations done in the course of computing reactivity feedback, due to core-assembly bowing, are shown to be acceptable for practical applications. Nevertheless, the technique used for performing these computations is shown to be systematically biased. A new technique, the Corrected Triangular Homogenization Scheme is presented and benchmarked for realistic cases. It is shown to be accurate for these cases. It is implemented in an automated computer code, RHOBOW.

43272 (IAEA-TECDOC—412, pp 73-88) **Thorium oxide blanket fabrication for Indian fast breeder test reactor.** Balakrishna, P.; Varma, B.P.; Rajendran, R.; Balaramamoorthy, K. (Department of Atomic Energy, Hyderabad, India. Nuclear Fuel Complex). Mar 1987. NTIS (US Sales Only), PC A08/MF A01. File Number DE87702566. (CONF-8512120—).

From International Atomic Energy Agency technical committee on utilization of thorium-based nuclear fuel: current status and perspectives; Vienna, Austria (2 Dec 1985).

For an effective utilization of Thorium in FBRs, use of fertile blanket of thorium oxide/thorium must be considered. Development of a reliable and economic fabrication technique of this fertile material, thus is an important step in the ultimate goal of utilization of thorium in FBRs. Fabrication and supply of blanket assemblies containing thorium oxide pellets to the requisite quality, for full core of Indian Fast Breeder Test Reactor, is one of the important tasks of Nuclear Fuel Complex at Hyderabad, a unit of the Department of Atomic Energy. Starting with ThO/sub 2/-powder obtained by oxalate precipitation and calcination, green pellets are produced through powder metallurgical route. In order to achieve sintered densities more than 94% T.D., addition of Mg in small quantities, during oxalate precipitation stage, have been found quite effective. The effect of compacting pressure, green density and sintering temperature on final sintered density of pellets and percentage of shrinkage have been studied to arrive at the optimum fabrication parameters, to yield high density in pellets requiring minimum amount of grinding. The compactability and sinterability characteristics seem to be affected by long storage of powder. Ball milling of powder before pre-compaction and granulation almost restore the original characteristics of the powder. The paper deals with the Indian experience on fabrication of thoria pellets for the Fast Breeder Test Reactor, with some emphasis on the work carried out for standardization of the parameters, quality characteristics of the pellets and on blanket assemblies made. Performance test of these assemblies under actual operating conditions of FBTR, followed by reprocessing studies, will be of great value for the Indian programme of utilization of thorium in the envisaged FBR's. 7 refs, 6 figs, 2 tabs.

43273 **Resonance self-shielding near zone interfaces.** Mo, S.C.; Ott, K.O. (Purdue Univ., School of Nuclear Engineering, West Lafayette, IN 47906). *Nuclear Science and Engineering;* **96**: No. 2, 112-121(Jun 1987).

A practical methodology is developed to treat the resonance self-shielding transition near zone interfaces. Based on the narrow resonance approximation, a space- and energy-dependent self-shielding factor for a single interface system is derived from the integral transport theory. Using the Wigner rational approximation, the self-shielding factor for a fine region near a zone interface is factorized into a linear combination of individual homogeneous and heterogeneous self-shielding factors. The method has been implemented in a widely used cross-section processing code that is based on the Bondarenko f-factor method. The result of the analysis was applied to a fast reactor blanket mock-up to improve the calculations near a converter-blanket interface. Comparisons of the calculation with / sup 238/U capture experimental data measured in the Purdue Fast Breeder Blanket Facility are also discussed.

2106 Power Reactors, Auxiliary, Mobile, Package, And Transportable

REFER ALSO TO CITATION(S) 43321

43274 (LA-UR—87-2003) Nuclear reactor power for an electrically powered orbital transfer vehicle. Jaffe, L.; Beatty, R.; Bhandari, P.; Chow, E.; Deininger, W.; Ewell, R.; Fujita, T.; Grossman, M.; Kia, T.; Nesmith, B. (California Inst. of Tech., Pasadena (USA); Los Alamos National Lab., NM (USA); National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1987. Contract W-7405-ENG-36. 8p. (CONF-870558—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011775.

From 19. international electric propulsion conference; Colorado Springs, CO, USA (11 May 1987).

To help determine the systems requirements for a 300-kWe space nuclear reactor power system, a mission and spacecraft have been examined which utilize electric propulsion and this nuclear reactor power for multiple transfers of cargo between low Earth orbit (LEO) and geosynchronous Earth orbit (GEO). A propulsion system employing ion thrusters and xenon propellant was selected. Propellant and thrusters are replaced after each sortie to GEO. The mass of the Orbital Transfer Vehicle (OTV), empty and dry, is 11,000 kg; nominal propellant load is 5000 kg. The OTV operates between a circular orbit at 925 km altitude, 28.5 deg inclination, and GEO. Cargo is brought to the OTV by Shuttle and an Orbital Maneuvering Vehicle (OMV); the OTV then takes it to GEO. The OTV can also bring cargo back from GEO, for transfer by OMV to the Shuttle. OTV propellant is resupplied and the ion thrusters are replaced by the OMV before each trip to GEO. At the end of mission life, the OTV's electric propulsion is used to place it in a heliocentric orbit so that the reactor will not return to Earth. The nominal cargo capability to GEO is 6000 kg with a transit time of 120 days; 1350 kg can be transferred in 90 days, and 14,300 kg in 240 days. These capabilities can be considerably increased by using separate Shuttle launches to bring up propellant and cargo, or by changing to mercury propellant.

43275 (N—87-22003) Coaxial tube array space transmission line characterization. Switzer, C.A.; Bents, D.J. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1987. 12p. (CONF-870804—23; NASA-TM—89864; E—3531; NAS—1.15:89864). NTIS, PC A02/MF A01.

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

The coaxial tube array tether/transmission line used to connect an SP-100 nuclear power system to the space station was characterized over the range of reactor-to-platform separation distances of 1 to 10 km. Characterization was done with respect to array performance, physical dimensions and masses. Using a fixed design procedure, a family of designs was generated for the same power level (300 kWe), power loss (1.5 percent), and meteoroid survival probability (99.5 percent over 10 yr). To differentiate between vacuum insulated and gas insulated lines, two different maximum values of the E field were considered: 20 kV/cm (appropriate to vacuum insulation) and 50 kV/cm (compressed SF6). Core conductor, tube, bumper, standoff, spacer and bumper support dimensions, and masses were also calculated. The results of the characterization show mainly how transmission line size and mass scale with reactor-to-platform separation distance.

43276 (N—87-23027) SP-100 advanced technology program. Sovie, R.J. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1987. 12p. (CONF-870804—35; NASA-TM—89888; E—3576; NAS—1.15:89888; AIAA—87-9232). NTIS, PC A02/MF A01.

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

The goal of the triagency SP-100 Program is to develop long-lived, compact, lightweight, survivable nuclear reactor space power systems for application to the power range 50 kWe to 1 MWe. The successful development of these systems should enable or significantly enhance many of the future NASA civil and commercial missions. The NASA SP-100 Advanced Technology Program strongly augments the parallel SP-100 Ground Engineering System Development program and enhances the chances for success of the overall SP-100 program. The purpose of this paper is to discuss the key technical elements of the Advanced Technology Program and the progress made in the initial year and a half of the project.

43277 (SAND—86-1020) RSMASS: A preliminary reactor/shield mass model for SDI applications. Marshall, A.C. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1986. Contract AC04-76DP00789. 64p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87011573.

A simple mathematical model (RSMASS) has been developed to provide rapid estimates of reactor and shield masses for space-based reactor power systems. Approximations are used rather than correlations or detailed calculations to estimate the reactor fuel mass and the masses of the moderator, structure, reflector, pressure vessel, miscellaneous components, and the reactor shield. The fuel mass is determined either by neutronics limits, specific power limits, or fuel burnup limits - whichever yields the largest mass. RSMASS requires the reactor power and energy, 24 reactor parameters, and 20 shield parameters to be specified. This parametric approach should provide good mass estimates for a very broad range of reactor types. Reactor and shield masses calculated by RSMASS were found to be in good agreement with the masses obtained from detailed calculations.

2107 Regulation And Licensing

REFER ALSO TO CITATION(S) 43246, 43344, 43357, 43358, 43416

43278 (EPRI-NP—5330) Modeling ultrasonic inspection of nuclear components: Beam models and applications: Interim report. Thompson, R.B.; Gray, T.A. (Ames Lab., IA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Aug 1987. Contract W-7405-ENG-82. 112p. NTIS, PC A06/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303; 1; GPO Dep. File Number DE87014089.

Recent advances in the modeling of ultrasonic inspection of geometries frequently encountered in electric power plants are discussed. The first portion of the report reviews models developed by the Central Electricity Generating Board in the United Kingdom as part of their program to ensure the safety of the proposed Sizewell B pressurized water reactor. The CEGB models predict the ability to detect cracks in a variety of geometries typical of pressure vessel weldments. Included in this portion of the report are discussions of the physical principles of the CEGB models, the current status of the software codes implementing the models, and steps that might be taken to transfer this capability to the United States. The second portion to the report describes new modeling advances made by the investigators to simulate the detection and sizing of multi-branched intergranular stress corrosion cracks in reactor piping. These models are based on theoretical descriptions of both the beam profiles and ultrasonic scattering from the cracks. Previous work was based on a two-dimensional model for scattering from a Y-shaped crack. Here, a three-dimensional model for the scattering from the cracks is introduced and used in a series of simulation studies. Extensions of the prior Gaussian beam model to include more general beam profiles, such as the radiation of piston or axicon transducers, are also descrbed.

43279 (NUREG—0040-Vol.11-No.2) Licensee contractor and vendor inspection status report: Quarterly report, April 1987-June 1987. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Inspection and Safeguards). Aug 1987. 152p. NTIS, PC A08/MF A01 - GPO. File Number TI87900953.

This periodical covers the results of inspections performed by the NRC's Vendor Inspection Branch that have been distributed to the inspected organizations during the period from April 1987 through June 1987. (JDB)

43280 **(NUREG—0090-Vol.9-No.4) Report to Congress on abnormal occurrences, October-December 1986.** (Nuclear Regulatory Commission, Washington, DC (USA). Office for Analysis and Evaluation of Operational Data). Jul 1987. 57p. NTIS, PC A04/MF A01 - GPO. File Number TI87900928.

Section 208 of the Energy Reorganization Act of 1974 identifies an abnormal occurrence as an unscheduled incident or event which the Nuclear Regulatory Commission determines to be significant from the standpoint of public health or safety and requires a quarterly report of such events to be made to Congress. This report covers the period from October 1 to December 31, 1986. The report states that for this reporting period, there were three abnormal occurrences at the nuclear power plants licensed to operate. The events were (1) loss of low pressure service water systems at Oconee, (2) degraded safety systems due to incorrect torque switch settings on Rotors motor operators at Catawba and McGuire Nuclear Stations, and (3) a secondary system pipe break resulting in the death of four persons at Surry Unit 2. There were six abnormal occurrences at the other NRC licensees. One involved release of americium-241 inside a waste storage building at Wright-Patterson Air Force Base; three involved medical misadministrations, one therapeutic and two diagnostic; one involved a suspension of license for servicing teletherapy and radiography units; and one involved an immediately effective order modifying license and order to show cause issued to an industrial radiography company. There were no abnormal occurrences reported by the Agreement States. The report also contains information updating some previously reported abnormal occurrences.

43281 **(NUREG—0540-Vol.9-No.6) Title list of documents made publicly available: June 1-30, 1987.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Publications Services). Aug 1987. 504p. NTIS, PC A22 - GPO. File Number DE87900927.

This document is a monthly publication containing descriptions of information received and generated by the US NRC. This information includes: (1) docketed material associated with civilian nuclear power plants and other uses of radioactive materials; and (2) nondocketed material received and generated by NRC pertinent to its role as a regulatory agency. The following indexes are included: Personal Author Index, Corporate Author Index, Report Number Index, and Cross Reference to Principal Documents Index.

43282 **(NUREG—0750-Vol.24-Index.2) Indexes to Nuclear Regulatory Commission issuances, July-December 1986.** (Nuclear Regulatory Commission, Washington, DC (USA)). Jul 1987. 99p. NTIS, PC A05 - GPO. File Number DE87900950.

Digests and indexes for issuances of the Commission (CLI), the Atomic Safety and Licensing Appeal Panel (ALAB), the Atomic Safety and Licensing Board Panel (LBP), the Administrative Law Judge (ALJ), the Directors' Decisions (DD), and the Denials of Petitions of Rulemaking are presented in this document. These digests and indexes are intended to serve as a guide to the issuances.

43283 **(NUREG—0750-Vol.25-No.3) Nuclear Regulatory Commission issuances.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Publications Services). Mar 1987. 144p. NTIS, PC A07 - GPO. File Number DE87900952.

This report includes the issuances received during the specified period from the Commission (CLI), the Atomic Safety and Licensing Appeal Boards (ALAB), the Atomic Safety and Licensing Boards (LBP), the Administrative Law Judge (ALJ), the Directors' Decisions (DD), and the Denials of Petitions for Rulemaking (DPRM).

43284 **(NUREG/CR—2000-Vol.5-No.12) Licensee event report (LER) compilation for month of December 1986.** (Oak Ridge National Lab., TN (USA); Nuclear Regulatory Commission, Washington, DC (USA). Office for Analysis and Evaluation of Operational Data). Jan 1987. Contract AC05-84OR21400. 131p. (ORNL/NSIC—200-Vol.5-No.12). NTIS, PC A07/MF A01 - GPO. File Number TI87005545.

This monthly report contains Licensee Event Report (LER) operational information that was processed into the LER data file of the Nuclear Safety Information Center (NSIC) during the one month period identified on the cover of the document. The LERs, from which this information is derived, are submitted to the Nuclear Regulatory Commission (NRC) by nuclear power plant licensees in accordance with federal regulations. Procedures for LER reporting for revisions to those events occurring prior to 1984 are described in NRC Regulatory Guide 1.16 and NUREG-1061, Instructions for Preparation of Data Entry Sheets for Licensee Event Reports. For those events occurring on and after January 1, 1984, LERs are being submitted in accordance with the revised rule contained in Title 10 Part 50.73 of the Code of Federal Regulations (10 CFR 50.73 - Licensee Event Report System) which was published in the Federal Register (Vol. 48, No. 144) on July 26, 1983. NUREG-1022, Licensee Event Report System - Description of Systems and Guidelines for Reporting, provides supporting guidance and information on the revised LER rule.

2108 Economics

43285 **(Y/DG—18700) An emergency inventory system at the Oak Ridge Y-12 Plant.** Smith, S.E. (Oak Ridge Y-12 Plant, TN (USA)). 7 May 1987. Contract AC05-84OS21400. 4p. (CONF-870519—8). NTIS, PC A02. File Number DE87011803.

From 9. annual meeting of the European Safeguards Research and Development Association: safeguards and nuclear material management; London, UK (12 May 1987).

A portable, computerized system for taking an emergency inventory of special nuclear materials (SNM) is in operation at the Oak Ridge Y-12 Plant. It is identified as the EIS (Emergency Inventory System). The listing process is automated using bar-code technology and all comparisons are done on a personal computer. The components of the EIS are easily transported to any area of the plant where an inventory might have to be taken. The easy-to-use , menu-driven programming for the system is written in a widely used database management language that is standardized and easily upgraded. This paper discusses the development, operation, hardware, and software of the EIS.

22 NUCLEAR REACTOR TECHNOLOGY

REFER ALSO TO CITATION(S) 44805, 44809

2201 Theory And Calculation

43286 **(JAERI-M—87-037) Calculation methods of atomic number density for various nuclear materials.** Komuro, Yuichi; Sakai, Tomohiro; Nakamaru, Shou-ichi. (Japan Atomic Energy Research Inst., Tokyo). Mar 1987. 52p. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. File Number DE87753006.

Microscopic cross sections for criticality calculations are calculated by summarizing products of microscopic cross sections and atomic number densities of each nuclides contained in the region. This calculation, indeed, is not so difficult, but the results are slightly different due to some differences of data used such as atomic weight, Avogadro number, theoretical fuel density. Then, atomic number density calculation equations based on experimental data and reliable physical constants were collected, and theoretical equations for calculating atomic number density were derived in this report. AND - a program for calculation of atomic number density were made based on these equations and data. Users of the program can easily get atomic number densities of various nuclear materials with high reliability.

43287 **(JAERI-M—87-057) Evaluation of calculational errors with the nuclear criticality safety analysis code system JACS.** Okuno, Hiroshi; Naito, Yoshitaka. (Japan Atomic Energy Research Inst., Tokyo). Mar 1987. 32p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. File Number DE87753005.

In order to guarantee subcriticality of nuclear fuels, the method to multiply a safety factor to the minimum critical quantities is sometimes adopted. The safety factor is, however, not rationally determined. Therefore, a method to set a limit to the effective neutron multiplication factor is investigated in this report. Using the nuclear criticality safety analysis code system JACS, about 1,400 cases of validation caluculations have been carried out since 1980. We treated 400 cases from the 1,400 as the sample cases of validation calculations which were based on the experimental systems neither of complex geometries nor of neutron poisoning. We devided the 400 cases into 8 groups according to the characteristics of the nuclear fuel materials. From the distribution of the effective neutron multiplication factors in each group, we obtained the limiting value of the effective neutron multiplication factor.

2202 Components And Accessories

REFER ALSO TO CITATION(S) 43207, 43278, 43334, 43336, 43350, 43360, 43535, 43780

43288 **(CONF-870812—25) Analysis of piping response to thermal and operational transients.** Wang, C.Y. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 7p. NTIS, PC A02. File Number DE87011471.

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

The reactor piping system is an extremely complex three-dimensional structure. Maintaining its structural integrity is essential to the safe operation of the reactor and the steam-supply system. In the safety analysis, various transient loads can be imposed on the piping which may cause plastic deformation and possible damage to the system, including those generated from hydrodynamic wave propagations, thermal and operational transients, as well as the seismic events. At Argonne National Laboratory (ANL), a three-dimensional (3-D) piping code, SHAPS, aimed for short-duration transients due to wave propagation, has been developed. Since 1984, the development work has been shifted to the long-duration accidents originating from the thermal and operational transient. As a result, a new version of the code, SHAPS-2, is being established. This paper describes many features related to this later development. To analyze piping response generated from thermal and operational transients, a 3-D implicit finite element algorithm has been developed for calculating the hoop, flexural, axial, and torsional deformations induced by the thermomechanical loads. The analysis appropriately accounts for stresses arising from the temperature dependence of the elastic material properties, the thermal expansion of the materials, and the changes in the temperature-dependent yield surface. Thermal softening, failure, strain rate, creep, and stress ratching can also be considered.

43289 **(DOE/NE/37959—6) Signal validation algorithms for consistency checking and sequential probability ratio testing of redundant measurements: Topical report.** Gloeckler, O.; Upadhyaya, B.R.; Kerlin, T.W. (Tennessee Univ., Knoxville (USA). Dept. of Nuclear Engineering). Jul 1987. Contract AC02-86NE37959. 41p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013657.

This report discusses the basic principles and recent developments of a signal validation software system utilizing redundant sensor readings. The purpose of this work is to develop a system of computer software for validating signals in nuclear power plants. The feasibility and performance of the above software system have been demonstrated in numerical tests, and will be discussed in this report.

43290 **(EPRI-NP—5263) Production of intergranular attack of alloy 600, alloy 690, and alloy 800 tubing in tubesheet crevices: Topical report.** Scott, D.B.; Glaves, C.L.,. (Combustion Engineering, Inc., Windsor, CT (USA). Nuclear Power Systems; Electric Power Research Inst., Palo Alto, CA (USA)). Jul 1987. 212p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920497.

Three model boilers, manufactured to simulate full-size tube sheet crevices, were tested with various secondary side environments. The first was faulted with organics representative of the decomposition of humic acid. The second was faulted with sodium carbonate and sodium hydroxide, while the third was faulted with sodium sulfate and sodium hydroxide. Each model contained seven tubes, which included Alloy 600 in the mill-annealed (MA) and thermally-treated (TT) conditions and Alloy 690 in the thermally-treated condition. Two models contained Alloy 800 tubes in the mill-annealed condition and one had Alloy 800 in the mill-annealed/cold-worked/glass-bead-peened condition. Two different sizes of tubesheet crevices were used in all model boilers. In the organics-faulted boiler, tubes of Alloy 600MA, Alloy 690TT and Alloy 800MA experienced no significant intergranular attack (IGA); however, the Alloy 600TT had intergranular attack (IGA) three to four grains deep. The carbonate-caustic faulted boiler experienced throughwall stress corrosion cracking (SCC) in all tubes of Alloy 600 MA and Alloy 800 MA. Eddy current indications were present in Alloy 690TT, Alloy 600TT and Alloy 800 in the mill-annealed/cold worked/glass-bead-peened condition. Metallographic examination of tubes from the third model boiler, faulted with sodium sulfate and caustic, revealed IGA in the mill-annealed Alloy 600 tubes. The IGA was more extensive in an Alloy 600 tube annealed at 1700°F than an Alloy 600 tube annealed at 1875°F.

43291 **(INIS-mf—10936) Steam turbines of large output especially for nuclear power stations. Part 1.** Drahny, J.; Stasny, M. (eds.). (Skoda, Plzen (Czechoslovakia). Zavodni Pobocka Ceske Vedeckotechnicke Spolecnosti; Ceskoslovenska Akademie Ved, Prague. Ceskoslovenska Spolecnost pro Mechaniku). 1986. 79p. (CONF-8410470—Pt.1). NTIS (US Sales Only), PC A05/MF A01. File Number DE87702597.

From 8. conference on steam turbines of large output; Karlovy Very, Czechoslovakia (30 Oct 1984).

At the international conference, 53 papers were presented in 3 sessions dealing with the design of large output steam turbines, with problems of flow in steam turbines, and with the reliability and service life of steam turbines. Part 1 of the conference proceedings contains two introductory papers, one reviewing the 100 years history of steam turbines (not included in INIS), the other giving an overview of the development of steam turbines in the eighties; and the 13 papers heard in the session on steam turbine design, all inputted in INIS. (A.K.).

43292 (INIS-mf—10936, pp 26-35) **Development of steam turbines in the eighties.** Drahny, J. (Skoda, Plzen, Czechoslovakia). 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702597. (CONF-8410470—Pt.1).

From 8. conference on steam turbines of large output; Karlovy Very, Czechoslovakia (30 Oct 1984).

The development is characterized of steam turbines in the world over the past thirty years. The biggest units operating in nuclear power plants have been built by Alsthom Atlantique - 1500 MW at 1500 RPM, and General Electric - 1360 MW at 1800 RPM The total annual capacity of steam turbines manufactured in the world for conventional and nuclear power plants is estimated at 150,000 MW. A number of studies have been made demonstrating the possibility of a reduction in specific heat consumption in turbines thanks to the use of input steam parameters 31.5 - 35 MPa, 593 - 650 degC with double heating 565 - 593 degC. However, only Toshiba of Japan are building two turbines with a capacity of 700 MW per unit which will operate at 3600 RPM with steam pressure of 32 MPa and temperatures of 535/535/535 degC. Experience has shown that the life of critical components of steam turbines reaches 1.5 to 2.0 x 10/sup 5/ operating hours. Briefly discussed are questions of using steam turbines for the combined generation of power and heat for district heating. (Z.M.).

43293 (INIS-mf—10936, pp 39-46) **Choice of speed of rotation for nuclear turbines.** Morineau, J. (Alsthom-Atlantique, France). 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702597. (CONF-8410470—Pt.1).

From 8. conference on steam turbines of large output; Karlovy Very, Czechoslovakia (30 Oct 1984).

The factors are discussed affecting the choice of speed of steam turbines for nuclear power plants. Criteria influencing this choice include the mechanical behavior of turbines, their efficiency, technical and economic aspects, operating reliability and easy main-

tenance. A comparison is made of turbines operating at speeds of 1500 and 3000 RPM. Briefly discussed is the effect of weight and of the dimensions of both types of turbines on the level of capital costs of such turbines both for manufacturers and operators of power plants where they have been installed. It is stated that turbines operating at 1500 RPM have higher efficiency, better mechanical reliability and simpler maintenance. A comparison of the two types of turbines has shown that at a capacity of 1000 MW results are better for the lower speed. As concerns turbines with a capacity of 1300 MW and more, the advantages of types operating at 1500 RPM are even greater. Turbine manufacturers must, however, take into consideration not only the capital costs which require increased power but also the saturation of the market. (Z.M.).

43294 (INIS-mf—10936, pp 47-56) **Operating experiences with 1300 MW saturated steam turbines.** Keysselitz, J. (Rheinisch-Westfaelisches Elektrizitaetswerk A.G., Germany, F.R.). 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702597. (CONF-8410470—Pt.1).

From 8. conference on steam turbines of large output; Karlovy Very, Czechoslovakia (30 Oct 1984).

In the FRG, 1300 MW turbogenerators operating with saturated steam belong to the standard equipment of nuclear power plants. The first of them was connected to the grid in 1975, there are now four in operation and ten are being manufactured. Briefly described is the thermodynamic project of a turbine in which input steam parameters are around 7 MPa and 300 degC. Two main problem areas are outlined on which attention should be focused, namely erosion and corrosion and the behavior of the turbine when nominal speed is exceeded. Defects in the first operated unit installed at the Biblis nuclear power plant were manifested mainly in the fixed and rotor blades of the high pressure stage, in the discharge pipes and in the moisture separator. When the said problems were removed the operating results of the turbine and of the three others were good. (Z.M.).

43295 (INIS-mf—10936, pp 65-73) **Development of the combined moisture separator reheater for large nuclear steam turbines.** Moore, J.H. (General Electric Co., Schenectady, NY, USA. Large Steam Turbine-Generator Dept.). 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702597. (CONF-8410470—Pt.1).

From 8. conference on steam turbines of large output; Karlovy Very, Czechoslovakia (30 Oct 1984).

General Electric have manufactured a combined moisture separator and reheater for large steam turbines designed for nuclear power plants. The equipment reduces the complexity of tubings and reduces pressure losses caused previously by the necessity of placing a separate moisture separator and reheater vessels between the high pressure and low pressure stages of the turbine. The project is described of the combined equipment placed in one cylindrical vessel and a brief characteristic is presented of all stages of its development to the present end product. Three materials were tested for the internal tubing. The tests showed that the most suitable material for this purpose is ferritic stainless steel with a 12% chromium content which is similar to commercial alloy 409. This material showed excellent resistance to sensibilization and embrittlement at temperatures reached in the operation of the combined moisture separator/reheater. (Z.M.).

43296 (INIS-mf—10936, pp 74-88) **High velocity separators: a new and efficient way for moisture separation.** Cerdan, J.P.; Talleu, P. (Electricite de France, 75 - Paris. Service General de Radioprotection). 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702597. (CONF-8410470—Pt.1).

From 8. conference on steam turbines of large output; Karlovy Very, Czechoslovakia (30 Oct 1984).

With regard to the large throughflow of steam in turbines of big nuclear power plants (200 m/sup 3//h at 900 MW power) the drying of steam in the exhaust of the high pressure stage of the turbine requires large and high-cost vessels. The French company Electricite de France have therefore developed and tested a new and efficient type of moisture separator - the High Velocity Separator whose main advantages are considerably smaller size and greatly increased efficiency as compared with conventional moisture separators. A standard High Velocity Separator is 1.9 m long and has a diameter of 0.6 m. The higher efficiency is achieved by better moisture separation and lower pressure losses between the high pressure and low pressure stages of the turbine. Two prototype facilities have been installed since 1980 at the Bugey nuclear power plant. The results achieved in operation over 25,000 hours are fully satisfactory. The equipment has shown resistance to erosion and to mechanical and thermal stress. At present 100 units are under construction; they are to be installed in French nuclear power plants in turbines with a capacity of 900 or 1300 MW power. (Z.M.).

43297 (INIS-mf—10936, pp 89-95) **Specific regulation problems in nuclear power plant.** Domachowski, Z.; Bugala, G. (Polska Akademia Nauk, Gdansk. Inst. Maszyn Przeplywowych). 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702597. (CONF-8410470—Pt.1).

From 8. conference on steam turbines of large output; Karlovy Very, Czechoslovakia (30 Oct 1984).

Specific aspects of nuclear power plant control are discussed. The reactor/turbogenerator system is compared with respect to control with the system boiler/turbogenerator in conventional power plants. Briefly described are mathematical models and block diagrams of the two systems. It is stated that the structure of the two models is analogous but that there do exist substantial differences in the parameters of transfer functions of certain components of the models. The system reactor/turbogenerator is capable of responding very quickly by changing the position of control rods, to changes in power requirements of the power supply system. This cannot be achieved in fossil fuel burning boilers. (Z.M.).

43298 (INIS-mf—10936, pp 96-101) **Comparison of mathematical models for overspeed calculations of saturated steam turbines.** Miller, A.; Lewandowski, J. (Politechnika Warszawska, Poland. Inst. Techniki Cieplne). 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702597. (CONF-8410470—Pt.1).

From 8. conference on steam turbines of large output; Karlovy Very, Czechoslovakia (30 Oct 1984).

Mathematical models are compared for the calculation of overspeed processes in saturated steam turbines designed for nuclear power plants. The models are divided into two groups. Models of the first group can serve only for analyses of procedures related to the shutdown of turbines. Models of the second group may be used for analyzing a number of transient processes in saturated steam turbines. Briefly discussed are differences in the obtained results of calculations. The results are presented in graphs. (Z.M.).

43299 (NUREG/CR—4913) **Round-robin pretest analyses of a 1:6-scale reinforced concrete containment model subject to static internal pressurization.** Clauss, D.B. (ed.). (Sandia National Labs., Albuquerque, NM (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering Technology). May 1987. Contract AC04-76DP00789. 531p. (SAND—87-0891). NTIS, PC A23 - GPO. File Number TI87012895.

Analyses of a 1:6-scale reinforced concrete containment model that will be tested to failure at Sandia National Laboratories in the spring of 1987 were conducted by the following organizations in the United States and Europe: Sandia National Laboratories (USA), Argonne National Laboratory (USA), Electric Power Research Institute (USA), Commissariat a L'Energie Atomique (France), HM Nuclear Installations Inspectorate (UK), Comitato Nazionale per la ricerca e per lo sviluppo dell'Energia Nucleare e delle Energie Alternative (Italy), UK Atomic Energy Authority, Safety and Reliability Directorate (UK), Gesellschaft fuer Reaktorsicherheit (FRG), Brookhaven National Laboratory (USA), and Central Electricity Generating Board (UK). Each organization was supplied with a standard information package, which included construction drawings and actual material properties for most of the materials used in the model. Each organization worked independently using their own analytical methods. This report includes descriptions of the various analytical approaches and pretest predictions submitted by each organization. Significant milestones that occur with increasing pressure, such as damage to the concrete (cracking and crushing) and yielding of the steel components, and the failure pressure (capacity) and failure mechanism are described.

Analytical predictions for pressure histories of strain in the liner and rebar and displacements are compared at locations where experimental results will be available after the test. Thus, these predictions can be compared to one another and to experimental results after the test.

43300 (ORNL/RSIC—48, pp 15-41) **Approximate techniques for calculating gamma ray dose rates in nuclear power plants.** Lahti, G.P. (Sargent & Lundy, Chicago, IL). Sep 1986. NTIS, PC A08/MF A01. File Number DE87002165. (ANS/SD—86/17).

In Approximate calculational techniques for radiation protection applications (collection of papers presented at the November 1985 American Nuclear Society meeting).

Although today's computers have made three-dimensional discrete ordinates transport codes a virtual reality, there is still a need for approximate techniques for estimating radiation environments. This paper discusses techniques for calculating gamma ray dose rates in nuclear power plants where Compton scattering is the dominant attenuation mechanism. The buildup factor method is reviewed; its use and misuse are discussed. Several useful rules-of-thumb are developed. The paper emphasizes the need for understanding the fundamental physics and draws heavily on the old, classic references.

43301 (ORNL/RSIC—48, pp 43-55) **Approximating complex gamma source spectra for shielding calculations.** Shure, K. (Bettis Atomic Power Lab., West Mifflin, PA). Sep 1986. NTIS, PC A08/MF A01. File Number DE87002165. (ANS/SD—86/17).

In Approximate calculational techniques for radiation protection applications (collection of papers presented at the November 1985 American Nuclear Society meeting).

Two techniques are described for approximating detailed gamma-ray source spectra from fission and neutron capture for use in point kernel programs or analytic formulas to obtain estimates of dose rates or energy deposition rates in materials for a one-dimensional representation of a reactor shield. The means for assessing the reliability of such estimates is also presented. For both techniques, illustrative examples are given for spectra from capture of thermal neutrons in several elements.

43302 (ORNL/RSIC—48, pp 99-108) **Penetration shielding applications of CYLSEC.** Dexheimer, D.T.; Hathaway, J.M. (Bechtel Power Corp., San Francisco, CA). Sep 1986. NTIS, PC A08/MF A01. File Number DE87002165. (ANS/SD—86/17).

In Approximate calculational techniques for radiation protection applications (collection of papers presented at the November 1985 American Nuclear Society meeting).

With the increased industry interest in cost-effectively reducing operator exposures and with the development of the CYLSEC[1] gamma transport computer code at Bechtel, a comprehensive program was initiated to reduce penetration shielding but still provide a prudent degree of protection from radiation streaming. This program was more comprehensive than previous efforts due to the recently developed code and increased efforts to control project costs while still maintaining radiation exposures ALARA. By using the CYLSEC code's three-dimensional modeling and multi-source capabilities, the elimination of shielding was justified in many cases. Where shielding was necessary, it was optimized to reduce costs. For cases in which shielding was not practical or cost effective, the results are used to identify locations for future access controls (permanent or temporary) and to highlight areas of high radiation for use by health physicists in planning work activities.

43303 **Multiobjective programming approach to reliability allocation for nuclear power plants.** Cho, N.Z.; Papazoglou, I.A.; Bari, R.A. (Brookhaven National Lab., Dept. of Nuclear Energy, Upton, NY 11973). *Nuclear Science and Engineering;* **95**: No. 3, 165-188(Mar 1987).

A methodology for reliability allocation in nuclear power plants, which determines reliability characteristics of reactor systems, subsystems, and components (low-level criteria) that are consistent with a set of top-level performance criteria such as the likelihood of core damage, adverse health effects, and associated economics is presented. The methodology, based on the multiobjective programming technique in decision-theoretic approach, does not require elaborate value judgments in determining the low-level criteria. Central to the methodology are the concept of noninferiority and finding the noninferior solution set. Several results of the methodology application to a realistic problem are also provided.

2203 Fuel Elements

REFER ALSO TO CITATION(S) 43338

43304 **(CONF-870812—23) Fission gas retention in irradiated metallic fuel.** Fenske, G.R.; Gruber, E.E.; Kramer, J.M. (Argonne National Lab., IL (USA)). Jan 1987. Contract W-31109-ENG-38. 15p. NTIS, PC A02/M A01; 1; GPO Dep. File Number DE87011462.

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

Theoretical calculations and experimental measurements of the quantity of retained fission gas in irradiated metallic fuel (U-5Fs) are presented. The calculations utilize the Booth method to model the steady-state release of gases from fuel grains and a simplified grain-boundary gas model to predict the gas release from intergranular regions. The quantity of gas retained in as-irradiated fuel was determined by collecting the gases released from short segments of EBR-II driver fuel that were melted in a gas-tight furnace. Comparison of the calculations to the measurements shows quantitative agreement with both the magnitude and the axial variation of the retained gas content.

43305 **(IAEA-TECDOC—412) Thorium-based nuclear fuel: current status and perspectives. Proceedings of a technical committee meeting on utilization of thorium-based nuclear fuel: current status and perspectives held in Vienna, 2-4 December 1985.** (International Atomic Energy Agency, Vienna (Austria)). Mar 1987. 163p. (CONF-8512120—). NTIS (US Sales Only), PC A08/MF A01. File Number DE87702566.

From International Atomic Energy Agency technical committee on utilization of thorium-based nuclear fuel: current status and perspectives; Vienna, Austria (2 Dec 1985).

Until the present time considerable efforts have already been made in the area of fabrication, utilization and reprocessing of Th-based fuels for different types of reactors, namely: by FRG and USA - for HTRs; FRG and Brazil, Italy - for LWRs; India - for HWRs and FBRs. Basic research of thorium fuels and thorium fuel cycles are also being undertaken by Australia, Canada, China, France, FRG, Romania, USSR and other countries. Main emphasis has been given to the utilization of thorium fuels in once-through nuclear fuel cycles, but in some projects closed thorium-uranium or thorium-plutonium fuel cycles are also considered. The purpose of the Technical Committee on the Utilization of Thorium-Based Nuclear Fuel: Current Status and Perspective was to review the world thorium resources, incentives for further exploration, obtained experience in the utilization of Th-based fuels in different types of reactors, basic research, fabrication and reprocessing of Th-based fuels. As a result of the panel discussion the recommendations on future Agency activities and list of major worldwide activities in the area of Th-based fuel were developed. A separate abstract was prepared for each of the 9 papers in this proceedings series. Refs, figs and tabs.

43306 (IAEA-TECDOC—412, pp 21-26) **IAEA activities in nuclear fuel technology, performance and utilization including the role of thorium-based fuel.** Onufriev, V. (International Atomic Energy Agency, Vienna, Austria. Dept. of Nuclear Energy and Safety). Mar 1987. NTIS (US Sales Only), PC A08/MF A01. File Number DE87702566. (CONF-8512120—).

From International Atomic Energy Agency technical committee on utilization of thorium-based nuclear fuel: current status and perspectives; Vienna, Austria (2 Dec 1985).

The IAEA activities in nuclear fuel technology, performance and utilization are presented with special emphasis on thorium-based nuclear fuel. Utilization of thorium fuels in once-through

cycles is discussed, as well as, in closed thorium/uranium or thorium/plutonium fuel cycles.

43307 (IAEA-TECDOC—412, pp 67-72) **Basic research on utilization of thorium-based nuclear fuel.** Zhang, J.H.; Bao, B.R.; Xia, Y.X.; Wang, G.Q.; Zhu, J.B. (Academia Sinica, Shanghai, SH, China. Shanghai Inst. of Nuclear Research). Mar 1987. NTIS (US Sales Only), PC A08/MF A01. File Number DE87702566. (CONF-8512120—).

From International Atomic Energy Agency technical committee on utilization of thorium-based nuclear fuel: current status and perspectives; Vienna, Austria (2 Dec 1985).

The dependences of build-up of U-233, U-232, Pa-233 and fission products on integral neutron flux for ThO/sub 2/ samples irradiated in high flux ETR at constant neutron flux and steady spectrum have been investigated. From these experiments, we have accumulated experiences on further research for the behaviours of the irradiated ThO/sub 2/ under different irradiation conditions in reactor. 6 figs, 1 tab.

43308 (IAEA-TECDOC—412, pp 59-66) **Thorium utilization in solving the nuclear power fuel problem.** Slesarev, I.S.; Morozov, A.G.; Tsurikov, D.F. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). Mar 1987. NTIS (US Sales Only), PC A08/MF A01. File Number DE87702566. (CONF-8512120—).

From International Atomic Energy Agency technical committee on utilization of thorium-based nuclear fuel: current status and perspectives; Vienna, Austria (2 Dec 1985).

The future large nuclear energy appears to be a many-branched industry. Creation of such an industry and dimensions of its beneficial influence on the development of industrial production depends to a great extent on the capability to generate relatively low-priced fuel on the basis of commercial nuclear breeding. So far no universal approach has been available for solving the nuclear fuel problem, though some realistic and effective ways to ease its acuteness have been developed. The most radical means for solving the fuel problem is application of fast breeder reactors in combination with improved fuel utilization characteristics of the thermal reactors. Among the ways realizing the improved fuel balance in the thermal reactors emphasis should be placed on use of the Uranium-233 - Thorium cycle. The available estimates of fuel utilization by the thermal reactors on U/Th cycle are indicative of its attractiveness. The paper considers a method for Uranium buildup in the blankets of current fast reactors, required for transition to the Uranium-233 - Thorium cycle in the thermal systems. It is shown that thorium utilization contributes noticeably to the nuclear fuel resources. Combination of the Uranium-Plutonium and Thorium cycles ensures long-term fuel supply, makes the nuclear energy production more flexible and, at realistic requirements to the level of fast reactor breeding, enables the self-provision regime to be realized in future. 4 refs, 2 tabs.

43309 (JAERI-M—87-020) **Irradiation experiments of coated particle fuels by gas-swept capsules. (2). Irradiation by 75F4A and 75F5A capsules.** Ogawa, Toru; Fukuda, Kosaku; Kashimura, Satoru; Tobita, Tsutomu; Minato, Kazuo; Suzuki, Hiroshi; Matsushima, Hideo; Yamamoto, Katsumune. (Japan Atomic Energy Research Inst., Tokyo). Feb 1987. 86p. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. File Number DE87752977.

Coated fuel particles in loosely-packed condition and fuel compacts were irradiated in 75F4A and 75F5A capsules, respectively, in the 1st Be region of JMTR for four reactor periods (— 80 days). Each capsule consisted of three inner-capsules which were separated from each other. The samples in the 75F4A capsule were obtained from the first and second fabrication campaigns meeting the VHTR fuel specification. The fuels according to a preliminary specification had different sizes and were also charged in the 75F5A capsule. All samples in the 75F4A showed no failure during the first three reactor periods, and gave valuable data concerning fission-gas release behavior due to uranium contamination in outer pyrolytic carbon layer. The coated fuel particles in its upper inner-capsule reached 2.2 %-FIMA and experienced 1500 deg C, but R/B(/sup 88/Kr) was only about 1 x 10/sup -5/; the end-of-life fraction through-coating failure (diameter/sub EOL/) was 3 x 10/sup -4/. The fuel compacts in the middle inner-capsule of 75F5A were irradiated to 1.6 %FIMA at 1600 deg C maximum, but diameter/sub EOL/ was merely 5 x 10/sup -4/. Their end-of-life fraction defective SiC showed no statistically significant increase. Other data obtained were: Irradiation effects on pyrolytic carbon layers, Pd attack on SiC, fractional release of metal fission products and dimensional changes of fuel compacts.

2204 Control Systems

REFER ALSO TO CITATION(S) 43364

43310 (CONF-870822—5) **Use of expert systems in nuclear power plants.** Uhrig, R.E. (Oak Ridge National Lab., TN (USA)). Aug 1987. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013680.

From American Institute of Chemical Engineers summer national meeting; Minneapolis, MN, USA (16 Aug 1987).

43311 (EPRI-NP—5236) **Approaches to the verification and validation of expert systems for nuclear power plants: Final report.** Groundwater, E.H.; Donnell, M.L.; Archer, M.A. (Science Applications International Corp., McLean, VA (USA). Artificial Intelligence and Decision Aids Div.; Electric Power Research Inst., Palo Alto, CA (USA)). Jul 1987. 54p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920537.

This report describes some concepts and techniques for the Verification and Validation (V & V) of expert systems developed for nuclear power applications. Expert systems in general are divided into types based on the difficulty of performing V & V on each type. Both conventional software and expert system evaluation techniques are described, including lifecycle V & V testing, qualitative assessments and performance measurement. Lastly, a set of guidelines for the V & V of expert systems is developed by recommending techniques applicable to each of the six types of expert systems and to expert systems in general throughout their development lifecycle. These general guidelines must be tailored to the unique features and uses of each expert system developed for a nuclear power application.

43312 (NUREG—1284) **Program plan for correction of US instrument degradation or failure in the Upper Plenum Test Facility (UPTF) in the Federal Republic of Germany.** Rhee, G.S.; Chen, Y.S.; Shotkin, L.M. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor and Plant Systems). Jul 1987. 252p. NTIS, PC A12/MF A01 - GPO. File Number TI87900909.

This report documents, as of September, 1986, the investigation of the failure or degradation of some of the advanced two-phase flow instruments supplied by the United States Nuclear Regulatory Commission (USNRC) to the German Upper Plenum Test Facility (UPTF). These instruments include Tie-Plate Drag Bodies (DBs), Breakthrough Detectors (BTDs), Loop Drag Disc (DD) paddles, Fluid Distribution Grid (FDG) sensors, and Liquid Level Detector (LLD) sensors. The exact causes for these instrument degradations or failures are not known, but several potential causes have been identified. For DBs and BTDs, the primary mechanism for the degradation appears to be a leakage in the Inconel 600 strain gage encapsulation and the subsequent burnout of the strain gage elements. Excessive loads appear to be the cause of the degradation or failure of the drag discs. The degradation cause for most of the FDGs and LLDs may be either steam/water erosion or mechanical abrasion of the sapphire sensor tips. However, some of the FDG tips were found to be cracked also. The corrective actions are being directed towards identification of the primary causes for the instrument degradation or failure and methods of preventing recurrance and toward minimizing the impact on the test program. All possible action items are being reviewed to arrange them in terms of priority and the likelihood of success so that the best results can be obtained under the constraints of a fixed amount of resources and limited time.

43313 **(UCRL—96931) A logic flowgraph based concept for decision support and management of nuclear plant operation.** Guarro, S.B. (Lawrence Livermore National Lab., CA (USA)). 29 Jun 1987. Contract W-7405-ENG-48. 26p. (CONF-870818—1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012629.

From International post-SMIRT seminar on accident sequence modelling: human actions, system response, intelligent decision aids; Munich, F.R. Germany (24 Aug 1987).

In the US the evolution of automated decision support tools for plant operators has spanned from "event-oriented" diagnostic systems to "symptom-oriented" computer-based emergency operating procedures. A problem common to both kind of systems is in the initial level of effort required for development of the associated models and software. In the following we will discuss some of the general issues that arise in the development and application of these decision-support systems. We will also propose and discuss an approach founded on the application of an event diagnosis and plant stabilization philosophy. This approach is based on the use of logic flowgraph process-oriented models - arranged in a modular architecture and developed with the aid of an expert-system model builder - as a possible means of achieving the development of an automated and integrated plant management system. This approach should allow the developer to achieve a high process recovery and management capability with a focused and controlled expenditure of development time and resources.

43314 **Gadolinium burnable absorber optimization by the method of conjugate gradients.** Drumm, C.R.; Lee, J.C. (Sandia National Labs., Orgn. 2321, P.O. Box 5800, Albuquerque, NM 87185). *Nuclear Science and Engineering;* **96**: No. 1, 17-29(May 1987).

The optimal axial distribution of gadolinium burnable poison in a pressurized water reactor is determined to yield an improved power distribution. The optimization scheme is based on Pontryagin's maximum principle, with the objective function accounting for a target power distribution. The conjugate gradients optimization method is used to solve the resulting Euler-Lagrange equations iteratively, efficiently handling the high degree of nonlinearity of the problem.

2205 Environmental Aspects

REFER ALSO TO CITATION(S) 43347, 44031

43315 **(HEDL—7507) A preliminary report on the SRP [Savannah River Plant] source term study.** Woodley, R.E.; Baldwin, D.L. (Hanford Engineering Development Lab., Richland, WA (USA)). Sep 1984. Contract AC06-76FF02170. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003150.

The present report describes the experimental system developed for the measurement of fission product release from Savannah River Plant (SRP) fuels and the preliminary measurements performed on unirradiated SRP fuel specimens and simulated irradiated fuel to check out the system prior to its installation in a hot cell for measurements on irradiated SRP fuel.

43316 **(NUREG/CR—2907-Vol.5) Radioactive materials released from nuclear power plants: Annual report, 1984.** Tichler, J.; Norden, K.; Congemi, J. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Administration and Resources Management). Aug 1987. Contract AC02-76CH00016. 254p. (BNL-NUREG—51581-Vol.5). NTIS, PC A12/MF A01 - GPO. File Number TI87013757.

Releases of radioactive materials in airborne and liquid effluents from commercial light water reactors during 1984 have been compiled and reported. Data on solid waste shipments as well as selected operating information have been included. This report supplements earlier annual reports issued by the former Atomic Energy Commission and the Nuclear Regulatory Commission. The 1984 release data are summarized in tabular form. Data covering specific radionuclides are summarized.

43317 **(PB—87-198693/XAB) Prediction of the effects of nutrient loadings from a power plant at Perryman on the water quality of the Bush River estuary. Final report.** Rose, K.A.; Dwyer, R.L.; Turner, M.A. (Martin Marietta Environmental Systems, Columbia, MD (USA)). Oct 1986. 255p. NTIS, PC A12/MF A01.

A water-quality model consisting of a one-dimensional Hydraulic Module coupled with a Water Quality Module was used to assess the effects of increased nutrient loadings from the proposed Perryman Power Plant on the dissolved oxygen and chlorophyll-a concentrations in the Bush River estuary. The Hydraulic Module represented the longitudinal water movement (and physical transport of associated constituents) among 12 spatial segments. The Water Quality Module represented the biological processes affecting nitrogen, phosphorus, chlorophyll-a, and dissolved oxygen in each segment (e.g., photosynthesis, nutrient uptake, decomposition).

43318 **(UNI-M—76-Rev.2) Effluent radioanalytical program manual.** Diediker, L.P.; Sunday, T.H. Jr. (UNC Nuclear Industries, Inc., Richland, WA (USA)). 15 Nov 1984. Contract AC06-76RL01857. 141p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87012476.

This manual establishes the procedures to be used to UNC to analyze radioactivity in effluents from UNC facilities. The manual provides the schedules and procedures necessary to operate an efficient and valid effluent analysis program. Compliance with the procedures in this manual is mandatory for all effluent analyses performed by UNC personnel in the 105-N Building.

43319 **(YJT—86-33) Loviisa Power Station - final disposal of reactor waste - tracer investigations.** Kaerki, A.; Kaemaeraeinen, V.J. (Voimayhtioeiden Ydinjaetetoimikunta, Helsinki (Finland)). Sep 1986. 51p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87752413.

Tracer measurements by radioactive isotopes have been carried out at the Loviisa power plant site in order to assess the suitability of the bedrock for the final disposal of low- and intermediate-level reactor waste. The aim of these tracer measurements was to study the flow geometry, the flow velocity and dispersion in the selected sections between boreholes with nonsorbing tracers. The most open fractures were selected for the measurements and so the results given in this report represent the most conductive part of the bedrock, which also bears the greatest influence on the safety analysis. The groundwater flow in fractures was caused by pumping water out of one borehole. In single-well measurements, vertical flow velocities and the locations of the hydraulically well conducting fractured zones were checked in order to facilitate the planning of the subsequent multi-well measurements. The results obtained were used to determine the sections of the boreholes suitable for injecting the tracer and to position the packers so that vertical short-circuiting flows could be prevented in boreholes between the fractured zones. The multi-well measurements were started with a short half-life tracer to find out how fast tracers would go from one borehole to another. Later long half-life tracers were used to obtain the final results. The tracers were lanthanides in the DTPA complex form. The breakthrough curves were measured both from the pumped water and from samples taken from the borehole. Combined with sampling from the borehole the tracer techniques revealed that groundwater flowed in the fractured zone through different pathways and entered the pumped borehole at several distinct depths. Simple flow models were fitted to the results to form a suitable network of pathways for subsequent safety analysis.

2206 Research, Test, And Experimental Reactors

REFER ALSO TO CITATION(S) 43273, 43338, 43361

43320 **(ANL/RERTR/TM—8) Requalification of SPERT [Special Power Excursion Reactor Test] pins for use in university reactors.** Snelgrove, J.L.; Domagala, R.F.; Dates, L.R. (Argonne National Lab., IL (USA)). Dec 1986. Contract W-31109-ENG-38. 82p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87013983.

A series of nondestructive and destructive examinations have been performed on a representative sample of stainless steel-clad UO_2 fuel pins procured in the early-to-mid 1960s for the SPERT program. These examinations were undertaken in order to requalify the SPERT pins for use in converting university research reactors from the use of highly enriched uranium to the use of low-enriched uranium. The requalification program included visual and dimensional inspections of fuel pins and fuel pellets, radiographic inspections of welds, fill gas analyses, and chemical and spectrographic analyses of fuel and cladding materials. In general all attributes tested were within or very close to specified values, although some weld defects not covered by the original specifications were found. 1 ref., 4 figs., 11 tabs.

43321 **(CONF-860102—16) Recent BeO-reflector-controlled reactor experiments in ZPPR.** McFarlane, H.F.; Brumbach, S.B.; Carpenter, S.G.; Collins, P.J.; McKnight, R.D. (Argonne National Lab., Idaho Falls, ID (USA)). Jan 1986. Contract W-31109-ENG-38. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86007517.

From 3. symposium on space nuclear power systems; Albuquerque, NM, USA (13 Jan 1986).

Integral reactor physics measurements were performed on a BeO-reflected fast reactor assembly in the ZPPR facility during January and February of 1985. The measurements emphasized power distributions and reflector control worths in two different critical states. The measurements have been analyzed using three-dimensional deterministic and Monte Carlo methods and the ENDF/B-V.2 nuclear data library. Together the measurements and analyses form a modern, reliable, benchmark data set for testing calculational methods that will be used in predicting some of the design parameters for future space reactors.

43322 **(CONF-870424—9-FP) Benchmark physics tests in the metallic-fuelled assembly ZPPR-15.** McFarlane, H.F.; Brumbach, S.B.; Carpenter, S.G.; Collins, P.J. (Argonne National Lab., Idaho Falls, ID (USA)). 1987. Contract W-31109-ENG-38. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011528.

From American Nuclear Society international meeting on advances in reactor physics, mathematics and computation; Paris, France (27 Apr 1987).

Results of the first benchmark physics tests of a metallic-fueled, demonstration-size, liquid metal reactor are reported. A simple, two-zone, cylindrical conventional assembly was built with three distinctly different compositions to represent the stages of the Integral Fast Reactor fuel cycle. Experiments included criticality, control, power distribution, reaction rate ratios, reactivity coefficients, shielding, kinetics and spectrum. Analysis was done with 3-D nodal diffusion calculations and ENDFIB-V.2 cross sections. Predictions of the ZPPR-15 reactor physics parameters agreed sufficiently well with the measured values to justify confidence in design analyses for metallic-fueled LMRs.

43323 **(CONF-870601—19) Calculation of temperature coefficients of reactivity for EBR-II kinetic analyses.** Meneghetti, D.; Kucera, D.A. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011436.

From Annual meeting of the American Nuclear Society; Dallas, TX, USA (7 Jun 1987).

Temperature coefficients of reactivity for use in coupled neutronics-thermohydraulics kinetics codes, as for example the EROS code used for Experimental Breeder Reactor-II (EBR-II) kinetic analyses, are both loading and problem-modeling sensitive. To enable appropriate temperature coefficients to be calculated for differing loading configurations and differing subassembly groupings in the kinetics analyses, an addition ((TEMCO) has been made to the EBRPOCO code. EBRPOCO calculates detailed axially-delineated contributions of the linear and Doppler components of the power-reactivity-decrement (PRD) for every subassembly and control rod location in an EBR-II configuration. This paper provides the results of the EBR-II kinetics analysis and lists the temperature coefficients of reactivity for varying subassembly types and conditions.

43324 **(DOE/ER/01560—21) The University of Wisconsin, Nuclear Reactor Laboratory, Madison, Wisconsin: Annual report, Fiscal Year 1986-1987.** Cashwell, R.J. (Wisconsin Univ., Madison (USA)). 1987. Contract AC02-76ER01560. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013899.

This report presents information pertaining to the operation of the University of Wisconsin Nuclear Reactor (UWNR) for fiscal year 1986-1987. (JDB)

43325 **(GA-A—18916) Thermionic Irradiations Program: Final report.** (GA Technologies, Inc., San Diego, CA (USA)). Jul 1987. Contract AC03-85SF15953. 54p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87013330.

This report describes the testing and modeling of the fueled emitters and sheath insulator samples during FY-86.

43326 **(JAERI-M—87-055) Thermohydraulic characteristics analysis of natural convective cooling mode on the steady state condition of upgraded JRR-3 core, using COOLOD-N code.** Kaminaga, Masanori; Watanabe, Shukichi; Ando, Hiroei; Sudo, Yukio; Ikawa, Hiromasa. (Japan Atomic Energy Research Inst., Tokyo). Mar 1987. 93p. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. File Number DE87752971.

This report describes the results of the steady state thermohydraulic analysis of upgraded JRR-3 core under natural convective cooling mode, using COOLOD-N code. In the code, function to calculate flow-rate under natural convective cooling mode, and a heat transfer package have been newly added to the COOLOD code which has been developed in JAERI. And this report describes outline of the COOLOD-N code. The results of analysis show that the thermohydraulics of upgraded JRR-3 core, under natural convective cooling mode have enough margin to ONB temperature, DNB heat flux and occurance of blisters in fuel meets, which are design criterion of upgraded JRR-3.

43327 **(NUREG—1281) Evaluation of the qualification of SPERT [Special Power Excursion Reactor Test] fuel for use in non-power reactors.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Projects III, IV, V and Special Projects). Aug 1987. 90p. NTIS, PC A05 - GPO. File Number DE87900945.

This report summarizes the US Nuclear Regulatory Commission staff's evaluation of the qualification of the stainless-steel-clad uranium/oxide (UO_2) fuel pins for use in non-power reactors. The fuel pins were originally procured in the 1960's as part of the Special Power Excursion Reactor Test (SPERT) program. Argonne National Laboratory (ANL) examined 600 SPERT fuel pins to verify that the pins were produced according to specification and to assess their present condition. The pins were visually inspected under 6X magnification and by X-radiographic, destructive, and metallographic examinations. Spectrographic and chemical analyses were performed on the UO_2 fuel. The results of the qualification examinations indicated that the SPERT fuel pins meet the requirements of Phillips Specification No. F-1-SPT and have suffered no physical damage since fabrication. Therefore, the qualification results give reasonable assurance that the SPERT fuel rods are suitable for use in non-power reactors provided that the effects of thin-wall defects in the region of the upper end cap and low-density fuel pellets are evaluated for the intended operating conditions. 1 ref., 4 figs., 11 tabs.

43328 **(UNI—3251) Corrosion and hydriding of three zirconium alloys in N-Reactor process tube 0553.** Johnson, A.B. Jr. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1985. Contract AC06-76RL01857;AC06-76RL01830. 25p. (PNL—5400). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012223.

Coupons of three zirconium alloys - Zircaloy-2 (two lots and three metallurgical conditions); Zircaloy-4; and Zr-2.5Nb - were exposed in N-Reactor pressure tube 0553 for 155 days at 1.2×10^{20} n/cm^2, >1 MeV. Although the exposure was relatively mild, significant differences in hydriding trends were observed for the three alloys. Hydriding rates differed for the three alloys: the rates were

highest for Zircaloy-2, intermediate for Zircaloy-4, and lowest for Zr-2.5Nb. The corrosion rates for all three alloys were relatively low in the N-Reactor coolant. The temperatures at the in-flux and downstream out-of-flux locations were 250 to 258°C (482 to 496°F) and 260 to 268°C (500 to 514°F), respectively, which are lower than currently indicated for equivalent N-Reactor locations. The reactor was converting to steam production during the period of the test; but failure of a transformer delayed full steam operation until after the test was completed, which may explain the lower temperatures during the test.

43329 **Fission rates and high-energy neutron fluxes in the Purdue Fast Breeder Blanket Facility.** Vital, H.C.; Clikeman, F.M.; Ott, K.O. (Rua Visconde de Figueiredo 63/202 20.550 - Tijuca - Rio de Janeiro). *Nuclear Science and Engineering;* **96**: No. 2, 102-111(Jun 1987).

Fission rate measurements were performed in the Purdue Fast Breeder Blanket Facility (FBBF) and compared with two-dimensional 50-group diffusion calculations on an absolute basis. Fission rates in /sup 239/Pu, /sup 235/U, /sup 237/Np, /sup 238/U, and /sup 232/Th were measured using fused quartz fission track recorders. Calculations using the 1DX and 2DB codes, and the LIB-IV nuclear data library were compared with the measurements in the form of reaction rate calculated-to-experiment (C/E) trajectories. The investigations were aimed at providing an improved understanding and description of the high-energy neutron fluxes and reaction rate distributions. Also investigated were previously reported C/E reaction rate discrepancies in the blanket.

43330 **(N—87-22018) Investigation of the reaction of liquid hydrogen with liquid air in a pressure tube.** Karb, E.H. (National Aeronautics and Space Administration, Washington, DC (USA)). May 1987. Translation of Versuche uber die Reaktion von Flussigem Wasserstoff mit Flussiger Luft in einem Druckrohr rept. KFK-789 Kernforschungszentrun, Karlsruhe, West Germany, 1-58(Jul 1968). (NASA-TT—20010; NAS—1.77:20010). 87p. NTIS, PC A05/MF A01.

A pressure tube should protect the FR-2 reactor from the consequences of a hydrogen-air reaction, which is conceivable in the breakdown of several safety devices of the planned cold neutron source Project FR-2/16. The magnitudes and time pattern of the pressures to be expected were investigated. In the geometry used and the ignition mechanism selected, which is comparable to the strongest ignition process conceivable in the reactor, the reaction proceeds with greater probability than combustion. The combustion is possibly smaller if local limited partial detonations are superimposed. The magnitude of the pressure was determined by the masses of the reaction partners, liquid H_2 and liquid air, and determines their ratio to each other.

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REFER ALSO TO CITATION(S) 43318

43331 **(JAERI-M—87-041) Remedy for TGSCC in the in-pile tube of Oarai Water Loop No. 2 (OWL-2). The confirmatory tests for the THSI welding process.** Ikeshima, Yoshiaki; Abe, Hiroshi; Suzuki, Shinobu; Itami, Hiroharu; Umemoto, Tadahiro. (Japan Atomic Energy Research Inst., Tokyo). Mar 1987. 53p. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. File Number DE87752968.

Oarai Water Loop No. 2 (OWL-2) in the JMTR has been operated for the irradiation tests of LWR's fuel and structural materials under the simulated coolant conditions like those of LWRs since Januray 1972. In March 1983, during the 62nd JMTR operation cycle, the occurrence of small leaks from the in-pile tube made of Type 316 stainless steel was detected and the cracking in the welded zone at the top closure of the pressure tube was revealed by inspection. The metallurgical examinations identified the presence of transgranular stress corrosion cracking in the weld zone where the leaks took place. The countermeasures such as employing THSI (Tig Torch Heating Stress Improvement) welding procedure, adopting type 316 NG stainless steel piping as the pressure tube and installing a chloride ion monitor on the primary system of the loop were taken in replacing the in-pile tube with the new one to prevent transgranular stress corrosion cracking. This paper reports the contermeasures adopted in the fabrication of the new in-pile tube, particularly the confirmatory tests of THSI welding procedure.

43332 **(UNI-SA—190) Waterside corrosion, hydrogen pickup, and hydrogen redistribution in Zircaloy-2 pressure tubes during long exposure in N Reactor.** Lanning, D.D.; Johnson, A.B. Jr.; Trimble, D.J. (Pacific Northwest Lab., Richland, WA (USA); UNC Nuclear Industries, Inc., Richland, WA (USA)). 15 Jun 1987. Contract AC06-76RL01857;AC06-76RL01830. 21p. (PNL-SA—14555; CONF-870839—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012225.

From 3. international symposium on environmental degradation of materials in nuclear power systems: water reactors; Traverse City, MI, USA (30 Aug 1987).

The history and distribution of corrosion and hydriding in N Reactor Zircaloy pressure tubes have been monitored in a long-term surveillance program that has included sampling for local hydrogen concentration and metallographic determination of corresponding inner surface oxide layer thicknesses. General observations are: corrosion and hydriding are qualitatively well-correlated, and both are enhanced by radiation; the rates of corrosion and hydriding increase once an oxide layer of 12 to 15 μm is attained; and the ratio of hydrogen concentration to oxide thickness is highly scattered with maximum values corresponding to apparent pick-up rates greater than 100%. Azimuthal hydrogen content variations have been found that could account for the last observation above. The azimuthal and radial hydrogen distributions on a particular tube have been examined and analyzed. The following conclusions have been made: an azimuthal gradient exists in the wall-averaged hydrogen concentration, with maximum values at the top of the tube and minimum values at the bottom; radial (through-wall) surveys at the tube top and bottom reveal that it is the inner surface hydrogen which is relocated azimuthally; and combined thermal-hydraulic, thermal conduction and hydrogen diffusion calculations indicate that an inner surface azimuthal temperature gradient can exist within a tube, primarily due to slight fuel element eccentricity, which is of proper direction and magnitude to relocate the inner-wall hydrogen to the degree observed. When the redistribution trends are accounted for, predictions of further increase in peak tube hydrogen concentrations due to further reactor operation can be made with more confidence.

43333 **(UNI-SA—208) Pressure-tube failure probability assessment for a pressure-tube nuclear reactor.** Stamatelatos, M.G.; Barsell, A.W.; Dahms, C.F.; Scott, K.V. (GA Technologies, Inc., San Diego, CA (USA); UNC Nuclear Industries, Inc., Richland, WA (USA)). Jun 1987. Contract AC06-76RL01857. 9p. (CONF-870820—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012231.

From PSA 87: international topical meeting on probabilistic safety assessment and risk management; Zurich, Switzerland (31 Aug 1987).

A probabilistic model based on linear elastic fracture mechanics has been developed and applied to the N Reactor pressure tubes. The model tracks, as a function of time, the probability of wall penetration due to crack growth, the probability of brittle fracture (fracture toughness exceeded), and the probability of exceeding ASME Section XI code safety margins. Both normal operation and selected accidents (safe shutdown earthquake and pressure tube rupture event) were analyzed. Results help to define the future surveillance program for the pressure tubes.

2209 Reactor Safety

REFER ALSO TO CITATION(S) 43041, 43279, 43280, 43315, 43330, 44131, 44773

43334 (ANL/RAS—87-3) Reinforced flexural elements for TEMP-STRESS Program. Marchertas, A.H.; Kennedy, J.M.; Pfeiffer, P.A. (Argonne National Lab., IL (USA). Reactor Analysis and Safety Div.). Jun 1987. Contract W-31109-ENG-38. 52p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87012961.

The implementation of reinforced flexural elements into the thermal-mechanical finite element program TEMP-STRESS is described. With explicit temporal integration and dynamic relaxation capabilities in the program, the flexural elements provide an efficient method for the treatment of reinforced structures subjected to transient and static loads. The capability of the computer program is illustrated by the solution of several examples: the simulation of a reinforced concrete beam; simulations of a reinforced concrete containment shell which is subjected to internal pressurization, thermal gradients through the walls, and transient pressure loads. The results of this analysis are relevant in the structural design/safety evaluations of typical reactor containment structures. 22 refs., 13 figs.

43335 (BNL-NUREG—39974) Interfacing systems LOCAs [Loss of Coolant Accidents] at boiling water reactors. Chu, Tsong-Lun; Fitzpatrick, R.; Stoyanov, S. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 7p. (CONF-870820—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012493.

From PSA 87: international topical meeting on probabilistic safety assessment and risk management; Zurich, Switzerland (31 Aug 1987).

The work presented in this paper was performed by Brookhaven National Laboratory (BNL) in support of Nuclear Regulatory Commission's (NRC) effort towards the resolution of Generic Issue 105 "Interfacing System Loss of Coolant Accidents (LOCAs) at Boiling Water Reactors (BWRs)." For BWRs, intersystem LOCA have typically either not been considered in probabilistic risk analyses, or if considered, were judged to contribute little to the risk estimates because of their perceived low frequency of occurrence. However, recent operating experience indicates that the pressure isolation valves (PIVs) in BWRs may not adequately protect against overpressurization of low pressure systems. The objective of this paper is to present the results of a study which analyzed interfacing system LOCA at several BWRs. The BWRs were selected to best represent a spectrum of BWRs in service using industry operating event experience and plant-specific information/configurations. The results presented here include some possible changes in test requirements/practices as well as an evaluation of their reduction potential in terms of core damage frequency (CDF).

43336 (BNL-NUREG—40049) Managing the effects of aging and reliability improvement. Hall, R.E.; Taylor, J.H.; Boccio, J.L. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 12p. (IAEA-SM—295/40; CONF-870604—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013299.

From International symposium on safety aspects of the aging and maintenance of nuclear power plants; Vienna, Austria (29 Jun 1987).

Over recent years the electric power generating community has acknowledged the importance of the aging process on plant safety and availability. To cope with time-dependent degradation phenomenon that can affect active as well as passive components and lead to unacceptable, unanticipated failures requires research into the mechanisms of the aging process, advances in productive methods for assessing the aging impact on risk and availability, and a better understanding of power plant operations so that strategies for defending against this pervasive stress can be developed. This paper discusses current research advances and presents a framework to aid in the systematic integration of these three needs. As such it is anchored to research being conducted at Brookhaven National Laboratory in the areas of plant aging, life extension, reliability, performance indication, and risk assessment. The current question facing the industry can be simply stated. "How can an acceptable level of safety and availability be maintained throughout the operational life of a nuclear power plant?" The complexity of this question indicates that managing aging effects must be a continuous, coordinated process integrated with day-to-day tactical plant operation decisions. This implies that aging and reliability programs must be systemic properties of an organization's management, and that research into aging technology must be closely linked.

43337 (CEA-CONF—8795) Large sodium water reaction calculations in a LMFBR steam generator. Finck, P.; Lepareux, M.; Schwab, B.; Blanchet, Y. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. des Reacteurs a Neutrons Rapides). May 1986. 7p. (CEA-DRNR-P—332; CONF-860501—21). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752223.

From Conference on the science and technology of fast reactor safety; Channel Islands, UK (12 May 1986).

The French approach to the analysis of large and violent sodium water reactions is presented. The basis for choosing the Design Basis Accident is discussed. An energetical analysis of the physical phenomena involved stresses the specific needs for computing tools. The feature of these tools are then described, and a validation test is presented. Finally, industrial applications are described. 8 refs.

43338 (CONF-870812—22) Cladding failure margins for metallic fuel in the integral fast reactor. Bauer, T.H.; Fenske, G.R.; Kramer, J.M. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011460.

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

The reference fuel for Integral Fast Reactor (IFR) is a ternary U-Pu-Zr alloy with a low swelling austenitic or ferritic stainless steel cladding. It is known that low melting point eutectics may form in such metallic fuel-cladding systems which could contribute to cladding failure under accident conditions. This paper will present recent measurements of cladding eutectic penetration rates for the ternary IFR alloy and will compare these results with earlier eutectic penetration data for other fuel and cladding materials. A method for calculating failure of metallic fuel pins is developed by combining cladding deformation equations with a large strain analysis where the hoop stress is calculated using the instantaneous wall thickness as determined from correlations of the eutectic penetration-rate data. This method is applied to analyze the results of in-reactor and out-of-reactor fuel pin failure tests on uranium-fissium alloy EBR-II Mark-II driver fuel.

43339 (CONF-870812—24) Cladding failure probability modeling for risk evaluations of fast reactors. Mueller, C.J.; Kramer, J.M. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011465.

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

This paper develops the methodology to incorporate cladding failure data and associated modeling into risk evaluations of liquid metal-cooled fast reactors (LMRs). Current US innovative designs for metal-fueled pool-type LMRs take advantage of inherent reactivity feedback mechanisms to limit reactor temperature increases in response to classic anticipated-transient-without-scram (ATWS) initiators. Final shutdown without reliance on engineered safety features can then be accomplished if sufficient time is available for operator intervention to terminate fission power production and/or provide auxiliary cooling prior to significant core disruption. Coherent cladding failure under the sustained elevated temperatures of ATWS events serves as one indicator of core disruption. In this paper we combine uncertainties in cladding failure data with uncertainties in calculations of ATWS cladding temperature conditions to calculate probabilities of cladding failure as a function of the time for accident recovery.

43340 **(CONF-870816—25) Radiation heat transfer within and from high temperature plumes composed of steam and molten nuclear debris.** Condiff, D.W. (Argonne National Lab., IL (USA)). Mar 1987. Contract W-31109-ENG-38. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011463.

From 24. national heat transfer conference and exhibition; Pittsburgh, PA, USA (9 Aug 1987).

The Differential Approximation of Radiation Heat Transfer which includes anisotropic scattering is formulated to account for multiple source and temperature fields of multiphase flow. The formulation is applied to a simplified model of a plume consisting of high temperature emissive particles in steam at parametrically variable lower temperatures. Parametric model calculations are presented which account for spectral emission and absorption by steam using a band approximation as well as emission, absorption and scattering by the debris. The results are found to be far more sensitive to emission properties of individual particles, than to their scattering properties at high temperatures.

43341 **(CONF-870820—2) The Accident Sequence Precursor program: Methods improvements and current results.** Minarick, J.W.; Manning, F.M.; Harris, J.D. (Science Applications International Corp., Oak Ridge, TN (USA); Nuclear Regulatory Commission, Washington, DC (USA); Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87011648.

From PSA 87: international topical meeting on probabilistic safety assessment and risk management; Zurich, Switzerland (31 Aug 1987).

Changes in the US NRC Accident Sequence Precursor program methods since the initial program evaluations of 1969-81 operational events are described, along with insights from the review of 1984-85 events. For 1984-85, the number of significant precursors was consistent with the number observed in 1980-81, dominant sequences associated with significant events were reasonably consistent with PRA estimates for BWRs, but lacked the contribution due to small-break LOCAs previously observed and predicted in PWRs, and the frequency of initiating events and non-recoverable system failures exhibited some reduction compared to 1980-81. Operational events which provide information concerning additional PRA modeling needs are also described.

43342 **(CONF-871028—1) Expert systems for protective monitoring of facilities.** Carr, K.R. (Martin Marietta Energy Systems, Paducah, KY (USA)). 1987. Contract AC05-84OR21400. 16p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87010014.

From Instrument Society of America international conference and exhibit; Anaheim, CA, USA (5 Oct 1987).

In complex plants, the possibility of serious operator error always exists to some extent, but, this can be especially true during an experiment or some other unusual exercise. Possible contributing factors to operational error include personnel fatigue, misunderstanding in communication, mistakes in executing orders, uncertainty about the delegated authority, pressure to meet a demanding schedule, and a lack of understanding of the possible consequences of deliberate violations of the facility's established operating procedures. Authoritative reports indicate that most of these factors were involved in the disastrous Russian Chernobyl-4 nuclear reactor accident in April 1986, which, ironically, occurred when a safety experiment was being conducted. Given the computer hardware and software now available for implementing expert systems together with integrated signal monitoring and communications, plant protection could be enhanced by an expert system with extended features to monitor the plant. The system could require information from the operators on a rigidly enforced schedule and automatically log in and report on a scheduled time basis to authorities at a central remote site during periods of safe operation. Additionally, the system could warn an operator or automatically shut down the plant in case of dangerous conditions, while simultaneously notifying independent, responsible, off-site personnel of the action taken. This approach would provide protection beyond that provided by typical facility "scram" circuits. This paper presents such an approach to implementing an expert system for plant protection, together with specific hardware and software configurations. The Chernobyl accident is used as the basis of discussion.

43343 **(EGG-TMI—7703) Electromatic relief valve flow and primary system hydrogen storage during the TMI [Three Mile Island]-2 accident.** Kuan, P.; Tolman, E.L. (EG and G Idaho, Inc., Idaho Falls (USA)). May 1987. Contract AC07-76ID01570. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012435.

Based on valve test data and theory of critical flow through an orifice, the flow history through the TMI-2 electromatic relief valve during the accident is calculated. The cumulative flow amounts to 8.0×10^5 kg based on the Wyle test data, about 20% below the inventory depletion estimated for the Borated Water Storage Tank during the accident. Based on pressure changes during a period of valve cycling before system depressurization and hydrogen venting to the containment, the hydrogen stored in the primary system is calculated to be about 450 kg, consistent with other estimates of total hydrogen generation during the accident.

43344 **(EPRI—7900891) Advanced light water reactor requirements document: Chapter 3, Reactor coolant system and reactor non-safety auxiliary systems.** (Combustion Engineering, Inc., Windsor, CT (USA); Duke Power Co., Charlotte, NC (USA); General Electric Co., Fairfield, CT (USA); Bechtel Power Corp., Gaithersburg, MD (USA); Levy (S.), Inc., Campbell, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jun 1987. 220p. NTIS, PC A10/MF A01. File Number DE87900891.

The purpose of this chapter of the Advanced Light Water Reactor (ALWR) Plant Requirements Document is to establish utility requirements for the design of the Reactor Coolant System and the Reactor Non-safety Auxiliary Systems of Advanced LWR plants consistent with the objectives and principles of the ALWR program. The scope of this chapter covers the reactor coolant system and reactor non-safety auxiliary systems for Pressurized Water Reactors (PWR) and Boiling Water Reactors (BWR). Non-safety auxiliaries include systems which are required for normal operation of the plant but are not required to operate for accident mitigation or to bring the plant to a safe shutdown condition. For PWRs, the reactor coolant system, steam generator system, chemical and volume control system and boron recycle system are included. For BWRs, the reactor coolant system and reactor water cleanup system are included. The chapter also includes requirements for the above systems which are common to BWRs and PWRs and requirements for process sampling for BWRs and PWRs.

43345 **(EPRI-NP—5238) Risk-based evaluation of technical specification problems at the La Salle County Nuclear Station: Final report.** Bizzak, D.J.; Trainer, J.E.; McClymont, A.S. (Delian Corp., Monroeville, PA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jun 1987. 193p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920507.

Probabilistic risk assessment (PRA) methods are used to evaluate alternatives to existing requirements for three operationally burdensome technical specifications at La Salle Nuclear Station. The study employs a decision logic to minimize the detailed analysis necessary to show compliance with given acceptance criteria; in this case, no risk increase resulting from a proposed change. The analyses provide insights to choose from among alternative options. The SOCRATES computer code was used for the probabilistic analysis. Results support a change to less frequent diesel generator testing, eliminations of one reactor scram setpoint, and establishing an allowed out-of-service time for valves in a reactor scram system. In each case, the change would result in a safety improvement.

43346 **(EPRI-NP—5278) A polymer-based chemical for oxide-scale removal and decontamination: Final report.** Fogel, D.M.; Cugini, A.V. (Pentek, Inc., Coraopolis, PA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jul 1987. 80p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920546.

This document details the experimental work performed with a self-stripping copolymer compound (PENTEK-600). Its ability to remove oxides and radioactive contamination from oxidized ferrous and non-ferrous surfaces and non-porous surfaces was evaluated. As a decontamination agent, the copolymer produced decontamination factors (DF's) of up to 245. Based on the experimental data, the underlying carbon steel surface condition after oxide removal using the copolymer was comparable to that achieved by commercial blast cleaning.

43347 **(EPRI-NP—5287-CCM) The RAFT computer code for calculating aerosol formation and transport in severe LWR [light-water reactor] accidents.** Im, K.H.; Ahluwalia, R.K.; Lin, H.C. (Argonne National Lab., IL (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jul 1987. Contract W-31109-ENG-38. 139p. NTIS, PC A07/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303; 1 ; GPO Dep. File Number DE87013125.

A computer code RAFT has been developed to predict the formation and transport of aerosols formed from condensation of volatile fission products released from breached fuel pins and structural materials vaporized during postulated severely degraded core accidents. The code is written in FORTRAN 77, has a modular structure, and is applicable to the primary systems of pressurized and boiling water reactors. RAFT presumes that the thermal hydraulic conditions and the release rates are known a priori and constitute inputs. The code in turn provides data which will form an input to the containment models for assessing the ability of the natural and engineered removal mechanisms in containing the fission products. The code also determines the retention of fission products in the primary system through particulate and vapor deposition mechanisms. RAFT has a unique capability of conducting ab initio calculation of aerosol size spectrum consistent with the gas phase equilibrium chemistry and the condensation chemistry. The capability results from the incorporation of homogeneous nucleation process into the model. Other processes considered in RAFT are heterogeneous nucleation, aerosol agglomeration, aerosol convection, aerosol deposition on structural surfaces, and vapor deposition/chemisorption on surfaces within the primary system. RAFT is currently being validated through analyses of the large-scale integrated experiments conducted at Marviken, the in-pile source term experiments (STEP) performed at ANL's TREAT reactor, and the bench scale separate-effect experiments carried out at ANL's hot tube facility.

43348 **(EPRI-NP—5344) Decontamination of Point Beach-1 and Surry-2 Steam Generator tubesheet sections: Final report.** Inman, S.C.; Frye, C.R. (Babcock and Wilcox Co., Lynchburg, VA (USA). Research and Development Div.; Electric Power Research Inst., Palo Alto, CA (USA)). Aug 1987. 87p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920543.

A full thickness tubesheet section containing thirteen tubes and two empty tube holes from a retired Point Beach-1 Nuclear Station Steam Generator was decontaminated by a combination of strong acids, weak acids, alkaline cleaning, electro cleaning and mechanical cleaning and sectioned by milling for subsequent examination by other contractors. A full thickness section of tubesheet from a retired Surry-2 steam generator containing four tubes was also decontaminated and sectioned by techniques similar to those used for the Point Beach assembly. Deposits and surfaces of the two empty holes in the Point Beach tubesheet were examined and the deposits were found to consist primarily of metal, and metal oxides (mainly iron). There were significant quantities of phosphorus and calcium compounds along with smaller amounts of sodium, sulfur and chloride compounds in the deposits.

43349 **(ESC-WR—86-23-Rev) After Chernobyl. Some conclusions about the effects of the Chernobyl accident on public opinion about nuclear power.** Midden, C.J.H.; Verplanken, B. (Netherlands Energy Research Foundation, Petten. Energy Study Centre). Nov 1986. 37p. (In Dutch). NTIS (US Sales Only), PC A03/MF A01. File Number DE87702561.

This report discusses a number of effects of the Chernobyl-accident on public opinion about nuclear power. The analysis is based on a comparison of a survey conducted shortly after Chernobyl and a number of measurements in the Netherlands between 1982 and 1986. The conclusions can be summarized as follows: Attitudes towards nuclear power and especially towards building new stations have become much more negative after the disaster in Chernobyl. Although a majority of the population now wants to close existing nuclear power stations, there appears strong support for continuation of nuclear research. The structure of the nuclear debate has not changed fundamentally. Supporters and opponents have kept the same demographic characteristics. The arguments which distinguish them have not changed, except that the expectation of a serious accident has an increased impact on attitudes. A majority of the population felt the information after the accident not sufficient. Since 1982 attitudes towards coal also have become more negative, mainly as a consequence of the higher visibility of effects of acid rain. 11 figures, 13 tables.

43350 **(IAEA-SM—295/35) Application of diagnostics to determine operational readiness of aged motor-operated valves.** Eissenberg, D.M. (Oak Ridge National Lab., TN (USA); International Atomic Energy Agency, Vienna (Austria)). 29 Jun 1987. Contract AC05-84OR21400. 14p. (CONF-870604—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011673.

From International symposium on safety aspects of the aging and maintenance of nuclear power plants; Vienna, Austria (29 Jun 1987).

Oak Ridge National Laboratory (ORNL) has been carrying out an aging assessment of motor-operated valves (MOVs) with the primary objective of recommending diagnostic methods for detecting and trending aging. As a result of experimental investigations at ORNL, it was discovered that the motor current during a valve stroke was a very useful diagnostic parameter for detecting and trending many MOV drive train load variations. The motor current signatures were analyzed at four levels: mean value for a stroke, gross trends during a stroke, transients, and noise frequency spectra. Examples illustrating the use of this technique are presented. The use of motor current signature analysis was also shown to apply to other electric motor driven equipment. Future work includes developing a data base of MOV diagnostics, including criteria for determining the extent of degradation and application of the technique to other LWR motor driven safety equipment.

43351 **(JAERI-M—87-019) Vectorization of the SONATINA-2V code for seismic analysis of the two-dimensional vertical slice HTGR core.** Tsuruoka, Takuya; Makino, Mitsuhiro; Ikushima, Takeshi; Ishiguro, Misako. (Japan Atomic Energy Research Inst., Tokyo). Feb 1987. 31p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. File Number DE87752982.

The SONATINA-2V code for analyzing the dynamic behavior of fuel blocks in the vertical slice of the HTGR (High Temperature Gas Reactor) core under the seismic perturbation has been vectorized. In this code, the behavior of fuel blocks which is described by a set of ordinary differential equations is numerically solved by the Runge-Kutta Method. In this numerical method, the equations can be calculated in parallel at each time step. In order to utilize this parallelism, the program structure has been changed, and the program has been optimized to effectively utilize the vector instructions of the vector processor. The processing time of the vectorized program on the FACOM VP-100 in the vector mode is reduced to about 1/6 in comparison with that of the original program in the scalar mode. The restructure of the program for representing the parallelism and the technique for the vector optimization are described. It is pointed out that the consideration for the program structure is important to obtain the high performance on the vector computer.

43352 **(JAERI-M—87-027) Dynamic behavior of pipe under loss of coolant accident.** Ueda, Shuzo. (Japan Atomic Energy Research Inst., Tokyo). Mar 1987. 194p. (In Japanese). NTIS (US Sales Only), PC A09/MF A01. File Number DE87753012.

This paper consists of six chapters. In the chapter one, a survey of past researches in the field of pipe whip and blowdown thrust force is described. The purpose of this paper is also included.

In the chapter two, the aim and specifications of Pipe Rupture Test Facility installed at JAERI is described. In the chapter three, the results of blowdown thrust force experiments and the estimation of analytical method regarding blowdown thrust force using RELAP4 and its post processor BLOWDOWN code. In the chapter four, the results of pipe whip experiments using 4, 6, and 8 inch test pipes and pipe whip restraints under BWR LOCA conditions. The influence of clearance, overhang length and diameter of test pipes on the pipe whip behavior is described. In the chapter five, the results of pipe whip analyses using a general purpose finite element program ADINA are described. The maximum restraint force due to impact of a ruptured pipe and pipe whip restraints can be predicted by this method. In addition, it is concluded that a simplified analysis method based on an energy balance is useful in order to determine the limit of the overhang length. In the chapter six, is described an example of application of the simplified method to real BWR plant piping and the whole conclusions.

43353 **(JAERI-M—87-043) BWR 2% main recirculation line break LOCA tests RUNs 915 and 920 without HPCS in ROSA-III program. Effects of pressure control system.** Suzuki, Mitsuhiro; Nakamura, Hideo; Anoda, Yoshinari; Kumamaru, Hiroshige; Yonomoto, Taisuke; Koizumi, Yasuo; Tasaka, Kanji. (Japan Atomic Energy Research Inst., Tokyo). Mar 1987. 235p. NTIS (US Sales Only), PC A11/MF A01. File Number DE87752992.

This report presents the experimental results of BWR LOCA integral tests, RUNs 915 and 920, which are performed in the ROSA-III program simulating 2 % main recirculation line break LOCA tests with and without pressure control system operation. The ROSA-III test facility simulates a BWR system with volume scale of 1/424 and has four half-length electrically heated fuel bundles, two active recirculation loops, four types of ECCS's, and steam and feedwater systems. The report presents (1) the experimental results of 2 % small break LOCA phanomena in the ROSA-III system and (2) the effects of the pressure control system on the LOCA phenomena. The pressure control system contributed to (A) prevent bulk flashing in the early blowdown phase, (B) early closure of MSIV by L2 level trip, (C) early actuation of ADS by L1 level trip. However, the core thermal responses of the two tests were similar because of the similar mass inventory in PV after the ADS actuation in both tests.

43354 **(JAERI-M—87-044) BWR LOCA integral test simulating a 100% main steam line break outside reactor containment vessel in ROSA-III program, RUN 955. Analogy of steam line break and recirculation line small break.** Suzuki, Mitsuhiro; Yonomoto, Taisuke; Anoda, Yoshinari; Kumamaru, Hiroshige; Nakamura, Hideo; Tasaka, Kanji. (Japan Atomic Energy Research Inst., Tokyo). Mar 1987. 163p. NTIS (US Sales Only), PC A08/MF A01. File Number DE87752996.

This report presents the ROSA-III experimental results of RUN 955, which simulates a 100 % steam line break (SLB) LOCA outside the BWR reactor containment vessel (RCV) with an assumption of high pressure core spray (HPCS) system failure. The ROSA-III test facility simulates a BWR system with volumetric scale of 1/424 and has the principal systems, i.e., four half-length electrically heated fuel bundles, two active recirculation loops, four types of ECCSs, and steam and feedwater systems. The report clarifies that the 100 % SLB LOCA outside the RCV becomes similar to a small SLB LOCA with the safety/relief valve (SRV) operation after the main steam isolation valve (MSIV) closure and that it is analogous to a small recirculation line break (RLB) LOCA with break area less than 2 % of the scaled pipe flow area.

43355 **(JAERI-M—87-051) Evaluation report on CCTF Core-II reflood test C2-16 (Run 76). Effect of asymmetric upper plenum injection on reflood phenomena.** Iguchi, Tadashi; Akimoto, Hajime; Okubo, Tsutomu; Hojo, Tsuneyuki; Murao, Yoshio; Sugimoto, Jun. (Japan Atomic Energy Research Inst., Tokyo). Mar 1987. 126p. NTIS (US Sales Only), PC A07/MF A01. File Number DE87753015.

This report presents the result of the upper plenum injection (UPI) test C2-16 (Run 76), which was conducted on October 23, 1984, with the Cylindrical Core Test Facility (CCTF) at Japan Atomic Energy Research Institute (JAERI). The CCTF is a 1/21.4 scale model of a 1,100 MWe PWR with four loop active components to provide information on the system and core thermo-hydrodynamics during reflood. The objectives of the test are to investigate the reflood phenomena with single failure UPI condition and to investigate the effect of the asymmetry of UPI on the reflood phenomena. The test was performed with an asymmetric UPI condition at the injection rate simulating single failure of LPCI pumps. It was observed that, (1) a UPI test simulating no LPCI pump failure gave the slightly lower peak clad temperature than a UPI test simulating single LPCI pump failure, indicating that single LPCI pump failure assumption is conserrative for UPI condition, and (2) an asymmetric UPI lead to a higher core water accumulation and then a higher heat transfer coefficient, resultantly a lower peak clad temperature than a symmetric UPI, indicating that asymmetric UPI does not lead to a poorer core cooling than symmetric UPI.

43356 **(JAERI-M—87-052) Evaluation report on CCTF core-II reflood test C2 - 18 (Run 78). Best estimated refill/reflood upper plenum injection test.** Iguchi, Tadashi; Akimoto, Hajime; Okubo, Tsutomu; Murao, Yoshio; Sugimoto, Jun; Hojo, Tsuneyuki. (Japan Atomic Energy Research Inst., Tokyo). Mar 1987. 123p. NTIS (US Sales Only), PC A06/MF A01. File Number DE87752999.

This report presents the result of the upper plenum injection (UPI) test C2 - 18 (Run 78), which was conducted on November 13, 1984 with the Cylindrical Core Test Facility (CCTF) at Japan Atomic Energy Research Institute (JAERI). The CCTF is a 1/21.4 scale model of a 1,100 MWe PWR with four loop active components to provide information on the system and core thermo-hydrodynamics during reflood phase. The objectives of the test are to investigate the refill behavior with UPI condition and to investigate the reflood behavior with UPI Best-Estimate (BE) condition. The test was performed to simulate refill/reflood behavior with UPI and BE conditions (However, the LPCI flow rate was determined based on single failure of LPCI pumps.). The result of the test showed the followings. (1) Little special phenomena were recognized under UPI and BE conditions in comparison with those under UPI and Evaluation-Model (EM) conditions, although certain special phenoma (i.e. significant fluid oscillation) were recognized under Cold-Leg-Injection (CLI) and BE conditions in comparison with those under CLI and EM conditions. (2) Water inventory in lower plenum increased smoothly due to water injected into both upper plenum and cold leg during refill phase, similarly to that in refill-simulation test with CLI condition. Small difference in refill behavior with UPI condition is the existing of steam condensation in upper plenum, resulting in lower steam binding and higher core cooling during early reflood phase. This indicates the conservatism of UPI against CLI during early reflood phase. (3) The good core-cooling capability was confirmed under UPI and BE conditions.

43357 **(NUREG—0781-Suppl.4) Safety evaluation report related to the operation of South Texas Project, Units 1 and 2 (Docket Nos. 50-498 and 50-499).** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Jul 1987. 160p. NTIS, PC A08/MF A01 - GPO. File Number TI87900929.

In April 1986 the staff of the Nuclear Regulatory Commission issued its Safety Evaluation Report (NUREG-0781) regarding the application of Houston Lighting and Power Company (applicant and agent for the owners) for a license to operate South Texas Project, Units 1 and 2 (Docket Nos. 50-498 and 50-499). The facility is located in Matagorda County, Texas, west of the Colorado River, 8 miles north-northwest of the town of Matagorda and about 89 miles southwest of Houston. The first supplement to NUREG-0781 was issued in September 1986, the second supplement in January 1987, and the third supplement in May 1987. This fourth supplement reports on the status of unresolved items in the Safety Evaluation Report and resolves all the issues necessary to support the issuance of a low-power license.

43358 **(NUREG—0936-Vol.6-No.2) NRC regulatory agenda: Quarterly report, April-June 1987.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Rules and Records). Jul 1987. 119p. NTIS, PC A06/MF A01 - GPO. File Number TI87900947.

This compilation summarizes significant enforcement actions that have been resolved during one quarterly period and includes copies of letters, Notices, and Orders sent by the Nuclear Regulatory Commission to licensees with respect to these enforcement actions. It is anticipated that the information in this publication will be widely disseminated to managers and employees engaged in activities licensed by the NRC, so that actions can be taken to improve safety by avoiding future violations similar to those described in this publication.

43359 **(NUREG—1057-Suppl.6) Safety evaluation report related to the operation of Beaver Valley Power Station, Unit 2 (Docket No. 50-412).** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Aug 1987. 82p. NTIS, PC A05/MF A01 - GPO. File Number TI87900956.

This report, Supplement No. 6 to the Safety Evaluation Report for the application filed by the Duquesne Light Company et al. (the licensee) for a license to operate the Beaver Valley Power Station, Unit 2 (Docket No. 50-412), has been prepared by the Office of Nuclear Reactor Regulation of the US Nuclear Regulatory Commission. This supplement reports the status of certain items that had not been resolved when the Safety Evaluation Report and its Supplements 1, 2, 3, 4, and 5 were published.

43360 **(NUREG—1264) Containment integrity research program plan.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering). Aug 1987. 34p. NTIS, PC A03/MF A01 - GPO. File Number TI87900955.

This report presents a plan for research on the question of containment performance in postulated severe accident scenarios. It focuses on the research being performed by the Structural and Seismic Engineering Branch, Division of Engineering, Office of Nuclear Regulatory Research. Summaries of the plans for this work have previously been published in the "Nuclear Power Plant Severe Accident Research Plan" (NUREG-0900). This report provides an update to reflect current status. This plan provides a summary of results to date as well as an outline of planned activities and milestones to the contemplated completion of the program in FY 1989.

43361 **(NUREG—1282) Safety Evaluation Report on high-uranium content, low-enriched uranium-zirconium hydride fuels for TRIGA [Training Research Isotopes GA] reactors (Docket No. 50-163).** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Aug 1987. 14p. NTIS, PC A02/MF A01 - GPO. File Number TI87900944.

The properties and performance of the TRIGA higher wt %, low-enriched uranium fuels are compared with those of the currently licensed 8.5 wt % fuels. Neutron physics considerations, materials properties, irradiation performance, fission product release, pulse heating, and limiting design basis were evaluated. The performance of uranium-zirconium hydride fuel is substantially independent of uranium content up to 45 wt % uranium. The behavior of the proposed 20- and 30-wt % uranium fuels is indistinguishable from that of the currently approved 8.5 wt % uranium fuel. Both the 20-20 and 30-20 uranium-zirconium hydride fuels are acceptable for use in the GA Mark F TRIGA reactor, and these two types of fuel are generically acceptable for use in other licensed TRIGA reactors, with the provision that case-by-case analyses discuss individual reactor operating conditions in applications for authorization to use them.

43362 **(NUREG/CR—4747-Vol.1) An aging failure survey of light water reactor safety systems and components.** Meale, B.M.; Satterwhite, D.G. (EG and G Idaho, Inc., Idaho Falls (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering Safety). Jul 1987. Contract AC07-76ID01570. 157p. (EGG—2473-Vol.1). NTIS, PC E06/MF A01. File Number TI87013863.

This report describes the methods, analyses, results, and conclusions of two different aging studies. The first analysis consists of a survey of light water reactor component failures associated with selected safety and support systems. Tables are presented, indicating the systems and the components within those systems most affected by aging. Also provided are engineering insights drawn from the data. The second analysis consists of identifying and categorizing the reported failure causes of component failures. The systems used in the failure-cause analysis were service water systems and Class 1E electrical power distribution systems for Babcock and Wilcox Company pressurized water reactors and service water systems for boiling water reactors.

43363 **(NUREG/CR—4767) Shutdown decay heat removal analysis of a General Electric BWR4/Mark I: Case study.** Hatch, S.W.; Ericson, D.M. Jr.; Sanders, G.A. (Sandia National Labs., Albuquerque, NM (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor and Plant Systems). Jul 1987. Contract AC04-76DP00789. 743p. (SAND—86-2419). NTIS, PC A99/MF A01 - GPO. File Number TI87013503.

A General Electric Boiling Water Reactor (BWR4) with a Mark I containment has been evaluated as part of Task Action Plan A-45, "Decay Heat Removal Requirements." Probabilistic risk assessment models were constructed to determine the dominant internal, randomly initiated accident sequences and special emergency sequences (e.g., earthquakes). The dominant sequences were reviewed to determine what modifications might be made to enhance the plant's ability to remove decay heat. Modifications which held promise went through a preliminary cost and design analysis. Additionally, the impact on the probability of core melt accidents was estimated given implementation of modifications. In the final step, these results were combined in a value-impact format according to NRC guidelines. The results indicate that feasible modifications to enhance decay heat removal do exist at the subject plant. The value-impact estimates for several modifications showed the potential for cost effectiveness under current guidelines. Alternate assumptions involving source term magnitude and interdiction criteria were found to significantly affect the results. The insights gained from this study will become part of an information base which will be used to develop generic recommendations regarding the adequacy of decay heat removal systems in light water reactors.

43364 **(NUREG/CR—4910) Relay chatter and operator response after a large earthquake: An improved PRA methodology with case studies.** Budnitz, R.J.; Lambert, H.E.; Hill, E.E. (Future Resources Associates, Inc., Berkeley, CA (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Accident Analysis). Aug 1987. 203p. NTIS, PC A10/MF A01 - GPO. File Number TI87900954.

The purpose of this project has been to develop and demonstrate improvements in the PRA methodology used for analyzing earthquake-induced accidents at nuclear power reactors. Specifically, the project addresses methodological weaknesses in the PRA systems analysis used for studying post-earthquake relay chatter and for quantifying human response under high stress. An improved PRA methodology for relay-chatter analysis is developed, and its use is demonstrated through analysis of the Zion-1 and LaSalle-2 reactors as case studies. This demonstration analysis is intended to show that the methodology can be applied in actual cases, and the numerical values of core-damage frequency are not realistic. The analysis relies on SSMRP-based methodologies and data bases. For both Zion-1 and LaSalle-2, assuming that loss of offsite power (LOSP) occurs after a large earthquake and that there are no operator recovery actions, the analysis finds very many combinations (Boolean minimal cut sets) involving chatter of three or four relays and/or pressure switch contacts. The analysis finds that the number of min-cut-set combinations is so large that there is a very high likelihood (of the order of unity) that at least one combination will occur after earthquake-caused LOSP. This conclusion depends in detail on the fragility curves and response assumptions used for chatter. Core-damage frequencies are calculated, but they are probably pessimistic because assuming zero credit for operator recovery is pessimistic. The project has also developed an improved PRA methodology for quantifying operator error under high-stress con-

ditions such as after a large earthquake. Single-operator and multiple-operator error rates are developed, and a case study involving an 8-step procedure (establishing feed-and-bleed in a PWR after an earthquake-initiated accident) is used to demonstrate the methodology.

43365 **(NUREG/CR—4945) Summary of the Semiscale Program, 1965-1986.** Loomis, G.G. (EG and G Idaho, Inc., Idaho Falls (USA); Nuclear Regulatory Commission, Washington, DC (USA)). Jul 1987. Contract AC07-76ID01570. 269p. (EGG—2509). NTIS, PC A12/MF A01 - GPO. File Number TI87013332.

This document summarizes significant results from the Semiscale Program, which examined pressurized water reactor (PWR) safety issues from 1965 to 1986. Most of these issues were related to plant response during loss-of-coolant accidents and operational transients. The Semiscale program utilized a series of nonnuclear, scaled, PWR plant simulators to provide thermal-hydraulic data at prototypical pressures and temperatures for a wide range of nuclear safety issues. Presented are: a historical perspective of the Semiscale Program relative to reactor safety with a catalog of the Semiscale experimental facilities and data bases, the relationship of Semiscale results to 10 CFR Part 50 (Appendix K), the impact of Semiscale results on scaling experimental results to full sized operating plants, a summary of safety issues that were addressed by Semiscale testing as they arose throughout the operational lifetime of Semiscale, the contributions of the Semiscale Program to safety technology, a description of phenomena observed during Semiscale testing, the impact of Semiscale data on code development and assessment, the applicability of the Semiscale data base for code development and assessment, and finally, major conclusions and accomplishments of the Semiscale program.

43366 **(NUREG/CR—4953) Correlation of radioiodine resuspension with temperature at TMI-2.** Daniel, J.A.; Daniel, E.A.; Seth, E.L. Jr. (Daniel and Associates, Silver Spring, MD (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Accident Analysis). Jul 1987. 136p. (DA-TR—8705). NTIS, PC A07/MF A01 - GPO. File Number TI87900898.

This report addresses the observed long term behavior of radioiodine in specific locations in the TMI-2 Auxiliary and Fuel Handling Buildings, and provides data on the behavior of ^{131}I at relatively low temperatures, (50 to 85°F) and non-equilibrium conditions, since the building ventilation systems were in operation. This report also discusses the observed effect of changes in the daily concentration of radioiodine due to diurnal temperature cycles, and establishes a numerical relationship between radioiodine concentration and ambient temperature.

43367 **(NUREG/CR—4962) Methods for the elicitation and use of expert opinion in risk assessment: Phase 1, A critical evaluation and directions for future research.** Mosleh, A.; Bier, V.M.; Apostolakis, G. (Pickard, Lowe and Garrick, Inc., Newport Beach, CA (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Accident Analysis). Aug 1987. 84p. (PLG—0533). NTIS, PC A05/MF A01. File Number TI87900958.

The purpose of this work is to critically review and evaluate the elicitation and use of expert opinion in probabilistic risk assessment (PRA) in light of the available empirical and theoretical results on expert opinion use. PRA practice is represented by five case studies selected to represent a variety of aspects of the problem: assessments of component failure rates and maintenance data; recent assessments of seismic hazard rates; assessments of containment phenomenology; assessments of human error rates; and accident precursor studies. The review has yielded mixed results. On the negative side, there appears to be little reliance on normative expertise in structuring the process of expert opinion elicitation and use; most applications instead rely primarily on the common sense of the experts involved in the analysis, which is not always an adequate guide. On the positive side, however, there is evidence that expert opinions can in fact be used well in practical settings. Suggestions are given for Phase II work to enhance the applicability and use of appropriate expert opinion methods.

43368 **(NUREG/CR—4972) Two-phase flow regime transition criteria in post-dryout region based on flow visualization experiments.** Obot, N.T.; Ishii, M. (Argonne National Lab., IL (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Accident Evaluation). Jun 1987. Contract W-31109-ENG-38. 53p. (ANL—87-27). NTIS, PC A04/MF A01 - GPO. File Number TI87013015.

A visual study of film boiling using photographic and high speed motion-picture methods was carried out to determine the flow regime transition criteria in the post-CHF region. An idealized inverted annular flow was obtained by introducing a liquid jet of Freon 113 through a nozzle, precisely centered with respect to the internal diameter of the test section, with an annular gas flow. The respective ranges for liquid and gas exit velocities were 0.05 to 0.5 and 0.03 to 7.9 m/s. Nitrogen and helium were used in the study. For the present configuration, there are four basic flow regimes. Beginning from the nozzle exit, there is a smooth, inverted annular flow section with liquid in the core and gas in the annulus; followed by the rough wavy section with an intact liquid core, the agitated and the dispersed flow regimes. For a given liquid jet velocity, the axial extent of each flow regime decreases with increasing gas velocity through the annulus. Generalized transition criteria and simplified correlations for the axial limits of the various flow regimes have been developed, by extending the results of previous studies on adiabatic inverted annular flow.

43369 **(PNCT-N—8420-86-10) Summary report on the environmental monitoring around Tokai area following the accident at Chernobyl nuclear power plant.** (Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan)). Dec 1986. 172p. (In Japanese). NTIS (US Sales Only), PC A08/MF A01. File Number DE87753023.

An accident took place at the Chernobyl nuclear power plant in USSR in the early hours of 26 April 1986. The plant caught fire and some degree of reactor inventry was released to the environment. Following the accident, debris of the radioactivity from Chernobyl was detected in all the European countries and countermeasures were taken in some countries. In Japan, many kinds of radionuclides were detected in rain, airbone dust and other environmental samples from 3 May and "Headquaters for Radioactivity Countermeasure" was organized in the Japanese Government. Health and Safety Division at the Tokai Works, PNC, performed the environmental monitoring for the Chernobyl accident in addition to the statutory monitoring program. This report presents results of the environmental monitoring performed at Tokai Works. Furthermore, study on the environmental transfer parameters and preliminary estimation of the committed dose equivalent to the public around Tokai area are discussed.

43370 **(SSI—86-10) Chernobyl - fallout, measurements and consequences.** Bennerstedt, T.; Holmberg, M.; Lindborg, L. (National Inst. of Radiation Protection, Stockholm (Sweden)). 25 Jun 1986. 42p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number DE87752423.

The radiation levels and the ground contamination in May 1986 from the Chernobyl accident are reviewed. The radiation doses to the most exposed persons in Sweden from the accident is estimated to be 4 mSv for the year 1986. The report also discusses radiation effects on main unit for radiation levels and doses etc.

43371 **(SSI—86-28) Project Chernobyl. Progress report 1.** (National Inst. of Radiation Protection, Stockholm (Sweden)). 20 Nov 1986. 29p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number DE87752417.

That type of activities by the institute are described which are a consequence of the reactor accident at Chernobyl. The measurement of radiactivity and the calculation of doses are reported. A number of research projects is listed. (G.B.).

43372 **(SSI—87-05) Project Chernobyl. Progress report 2.** (National Inst. of Radiation Protection, Stockholm (Sweden)). 3 Mar 1987. 23p. (In Swedish). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752418.

The aim of the follow-up after the Chernobyl fallout is to obtain the best possible information about the environmental and

dose commitment consequences in Sweden. The essential part of the work by the institute to improve the state of readiness is described. (G.B.).

25 ENERGY STORAGE

REFER ALSO TO CITATION(S) 44632

2502 Compressed Gas

REFER ALSO TO CITATION(S) 43417

2506 Thermal

43373 (AFME—83-855) Study of thermal energy storage by latent heat or chemical process and of system behaviour. Achard, P.; Gabriel, M.; Mayer, D.; Thomas, H.; Vialaret, C. (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1984. 113p. (In French). NTIS (US Sales Only), PC A06/MF A01. File Number DE87753148.

Several types of thermal energy storage are examined in this paper. A study of the radiative and conductive heat transfers in semitransparent phase transition materials (experimentals and models) and a study of storage materials having a solid state transition (polyalcohols, organic-metallic compounds) are presented - simulation of heat exchanges between a gaseous flow and packaged MCP spheres is also described, followed by a study of a thermochemical storage through a lime hydration - dehydration reaction. Survigel packs have been also tested for the enhaucement of freezer autonomy.

43374 (FRNC-TH—2360) Design of measuring lines of temperature, thermal conductivity, capillary succin and gas pressure in porous media. Application to heat storage in non saturated grounds. Koufogiannis, D. (Montpellier-2 Univ., 34 (France)). 1984. 107p. (In French). NTIS (US Sales Only), PC A06/MF A01. File Number DE87753157.

The aim of this study was to design a measuring apparatus chain used to control a non-saturated soil that serves as a thermal energy storage system. As the physical phenomenons during heat storage can last several months, automatic measuring is obvious. Data acquisition is performed through two modules: a thermometric data acquisition system measuring the temperature and the thermal conductivity of the soil, and a manometric system measuring the capillar suction and the gaseous phase total pressure. The hardware and software environment is also described.

43375 (N—87-22174) Selection of high temperature thermal energy storage materials for advanced solar dynamic space power systems. Lacy, D.E.; Coles-Hamilton, C.; Juhasz, A. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1987. 13p. (CONF-870804—25; NASA-TM—89886; E—3569; NAS—1.15:89886). NTIS, PC A02/MF A01.

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

Under the direction of NASA's Office of Aeronautics and Technology (OAST), the NASA Lewis Research Center has initiated an in-house thermal energy storage program to identify combinations of phase change thermal energy storage media for use with a Brayton and Stirling Advanced Solar Dynamic (ASD) space power system operating between 1070 and 1400 K. A study has been initiated to determine suitable combinations of thermal energy storage (TES) phase change materials (PCM) that result in the smallest and lightest weight ASD power system possible. To date the heats of fusion of several fluoride salt mixtures with melting points greater than 1025 K have been verified experimentally. The study has indicated that these salt systems produce large ASD systems because of their inherent low thermal conductivity and low density. It is desirable to have PCMs with high densities and high thermal conductivities. Therefore, alternate phase change materials based on metallic alloy systems are also being considered as possible TES candidates for future ASD space power systems.

2508 Chemical

REFER ALSO TO CITATION(S) 43172

2509 Batteries

REFER ALSO TO CITATION(S) 43681, 43690

43376 (AD-A—180862/5/XAB) Thermal-shock abuse of Panasonic Li/(CF) x 2/3A and C size cells. Technical report. Baker, J.W.; Kowalchik, L.A. (Naval Surface Weapons Center, Silver Spring, MD (USA). White Oak Lab.). 6 Sep 1985. 39p. (NSWC-TR—85-398). NTIS, PC A03/MF A01.

A change was made in the design of Panasonic poly-carbon monofluoride lithium batteries after a malfunction was discovered during temperature shocking. This report gives the results of temperature on batteries of the new design.

43377 (AD-A—181004/3/XAB) Development of a nickel oxide/hydrogen multilayer bipolar battery for pulsed power. Rauh, R.D.; Holleck, G.L. (EIC Labs., Inc., Norwood, MA (USA)). Apr 1987. 3p. NTIS, PC A02/MF A01.

Spaced-based missile defense systems will require sources of pulsed power to operate prospective directed energy weapons. In principle, an electrochemical power source can provide this power at a much lower weight than alternative magnetic or electric field devices (capacitors or inductors). However, advances must be made in high-rate thin-film electrode materials and in battery design. The authors are investigating electrochemical capacities under pulsed conditions for two promising materials: (1) LaNi5 which acts as hydrogen storage anode with high hydrogen diffusion rates and (2) a hydrated nickel oxide cathode with optimized mixed ionic and electronic conductivity. Thin films were prepared by reactive sputtering, vapor desposition, anodization of nickel and electrochemical precipitaiton of nickel hydroxide.

43378 (AD-A—181040/7/XAB) Safety characteristics of lithium primary and secondary battery systems. Formulation of a lithium battery safety matrix. Final report, October 1984-July 1986. Bis, R.F.; Barnes, J.A.; Zajac, W.V.; Davis, P.B.; Murphy, R.M. (Advanced Battery Group, Lancaster, NY (USA)). Jul 1986. 149p. NTIS, PC A07/MF A01.

A study was conducted to assess the safety characteristics for both primary and secondary lithium electrochemical systems. Of particular interest is the behavior of specific cell designs of these systems when subjected to the electrical and thermal abuse test procedures prescribed in NAVSEANOTE 9310. These abusive tests include short circuit, forced overdischarge, charge, and incineration. This report formulates a lithium battery safety matrix wherein certain electrochemical system, cell designs, or cell types that have exhibited exceptionally safe characteristics under abusive conditions may be exempt from some or all of the NAVSEANOTE 9310 test procedures.

43379 (CONF-871027—25) Evaluation of LiCl-LiBr-KBr electrolyte for Li-alloy/metal disulfide cells. Kaun, T.D. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011356.

From 172. meeting of the Electrochemical Society; Honolulu, HI, USA (18 Oct 1987).

The physical properties of a new molten salt electrolyte for lithium-alloy/metal disulfide cells, 25 mol % LiCl-37 mol % LiBr-38 mol % KBr, were investigated. Cyclic voltammetry of FeS_2 in the new molten salt at 375 to 425°C indicated improved electrochemistry and stability of the reaction on the upper voltage plateau (1.75 V vs. LiAl). The new electrolyte provides an opportunity to operate an upper-plateau (UP) FeS_2 electrode at a lower temperature, 400°C, and with a higher activity of lithium ion in the electrolyte. The broad liquidus of this molten salt at 400°C also supports operation at high current density. Testing of 24- to 48-Ah cells indicated greater than 50% improved energy and power density over the conventional two-plateau FeS_2 cell with LiCl-KCl electrolyte. The conventional FeS_2 cells would lose 50% of their upper-plateau

capacity within 200 cycles. The elimination of this capacity decline problem was demonstrated by 400 cycles and 5400 h of stable operation with a dense UP FeS_2 electrode cell, which maintained 89% utilization of theoretical capacity throughout the test.

43380 **(CONF-871027—26) Overcharge protection in Li-alloy/metal disulfide cells.** Redey, L. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011364.

From 172. meeting of the Electrochemical Society; Honolulu, HI, USA (18 Oct 1987).

Charge and overcharge reactions of FeS_2, NiS_2, and (Fe-Ni)S_2 electrodes were studied in half-cell and full-cell experiments to investigate the electrochemical stability of these materials at high charge potentials. In Li_2S-saturated (LiCl-KCl, LiF-LiCl-LiBr, and LiCl-LiBr-KBr) electrolytes, a new plateau appeared at 2.05-2.1 V vs Li-Al and was associated with polysulfide anion formation. The polysulfide seems to stabilize the transition-metal sulfides against overcharge-related dissolution, even at 2.2 V. The anodically formed polysulfide provides overcharge tolerance for Li-alloy/MS_2 cells by an electrochemical-chemical sulfide/polysulfide cycle.

43381 **(N—87-22307) Stress-life interrelationships associated with alkaline fuel cells.** Thaller, L.H.; Martin, R.E.; Stedman, J.K. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1987. 8p. (CONF-870804—26; NASA-TM—89881; E—3562; NAS—1.15:89881; AIAA—87-9198). NTIS, PC A02/MF A01.

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

A review is presented concerning the interrelationships between applied stress and the expected service life of alkaline fuel cells. Only the physical, chemical, and electrochemical phenomena that take place within the fuel cell stack portion of an overall fuel cell system will be discussed. A brief review will be given covering the significant improvements in performance and life over the past two decades as well as summarizing the more recent advances in understanding which can be used to predict the performance and life characteristics of fuel cell systems that have yet to be built.

43382 **(N—87-22308) Effect of storage and LEO cycling on manufacturing technology IPV nickel-hydrogen cells.** Smithrick, J.J. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1987. 9p. (CONF-870804—27; NASA-TM—89883; E—3566; NAS—1.15:89883; AIAA—87-9318). NTIS, PC A02/MF A01.

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

Yardney Manufacturing Technology (MANTECH) 50 A-hr space weight individual pressure vessel nickel-hydrogen cells were evaluated. This consisted of investigating: the effect of storage and charge/discharge cycling on cell performance. For the storage test the cells were precharged with hydrogen, by the manufacturer, to a pressure of 14.5 psia. After undergoing activation and acceptance tests, the cells were discharged at C/10 rate (5A) to 0.1 V or less. The terminals were then shorted. The cells were shipped to NASA Lewis Research Center where they were stored at room temperature in the shorted condition for 1 year. After storage, the acceptance tests were repeated at NASA Lewis. A comparison of test results indicate no significant degradation in electrical performance due to 1 year storage. For the cycle life test the regime was a 90 minute low earth orbit at deep depths of discharge (80 and 60 percent). At the 80 percent DOD the three cells failed on the average at cycle 741. Failure for this test was defined to occur when the cell voltage degraded to 1 V prior to completion of the 35 min discharge. The DOD was reduced to 60 percent. The cycle life test was continued.

43383 **(N—87-22311) Prediction model of the depth-of-discharge effect on the cycle life of a storage cell.** Thaller, L.H.; Lim, H.S. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1987. 9p. (CONF-870804—29; NASA-TM—89915; E—3608; NAS—1.15:89915; AIAA—87-9080). NTIS, PC A02/MF A01.

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

Cycle life requirements are very high for batteries used in aerospace applications in low Earth orbit. The data base required to establish confidence in a particular cell design is thus both extensive and expensive. Reliable accelerated cycle life testing and performance decay modeling represent attractive alternatives to real-time tests of cycle life. In light of certain long-term cycle life test results, this paper examines a very simple performance decay model developed earlier. Application of that model to available data demonstrates a rigid relationship between a battery's expected cycle life and the depth of discharge of cycling. Further, modeling analysis of the data suggests that a significantly improved cycle life can be obtained with advanced components, materials, and designs; and that cycle life can be reliably predicted from the results of accelerated testing.

43384 **(N—87-23029) Component variations and their effects on bipolar nickel-hydrogen cell performance.** Manzo, M.A.; Gahn, R.F.; Gonzalez-Sanabria, O.D.; Cataldo, R.L.; Gemeiner, R.P. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1987. 6p. (NASA-TM—89907; E—3600; NAS—1.15:89907; AIAA—87-9260; CONF-870804—34). NTIS, PC A02/MF A01.

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

A 50 cell bipolar nickel-hydrogen battery was assembled to demonstrate the feasibility of constructing a high voltage stack of cells. Various component combinations were tested in this battery. The battery had approximately 1 ampere-hour of capacity and was constructed from components with an active area of 2″ X 2″. The components were parametrically varied to give a comparison of nickel electrodes, hydrogen electrodes, separators, fill procedures and electrolyte reservoir plate thicknesses. Groups of five cells were constructed using the same components; ten combinations were tested in all. The battery was thoroughly characterized at various change and discharge rates as well as with various pulse patterns and rates. Over a period of 1400 40% DOD LEO cycles some of the groups began to exhibit performance differences. In general, only separator variations had a significant effect on cell performance. It also appears that shunt currents may have been operating within the stack, resulting in electrolyte transfer from one cell to another, thus contributing to cell performance variations.

43385 **(SAND—87-7127C) Zinc-Redox Battery: A technology update.** Hollandsworth, R.P. (Lockheed Missiles and Space Co., Palo Alto, CA (USA)). 1987. Contract AC04-76DP00789. 18p. (CONF-871027—20). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010737.

From 172. meeting of the Electrochemical Society; Honolulu, HI, USA (18 Oct 1987).

Since 1977, scientists at Lockheed Missiles and Space Company, Inc., have been developing the Zinc-Redox Battery for large-scale electrical energy storage. The current state of technology for this battery has demonstrated a number of positive features: (1) high energy efficiency (82.6 +- 4.4%) demonstrated for more than 754 cycles with a low-cost α-methyl styrene membrane; (2) minimal environmental concerns because the only toxic reactant is 2N sodium hydroxide, and thus low projected balance-of-plant costs; and (3) good cell performance over a wide range of discharge rates with cell IR being the main determinant of energy efficiency. Current studies have focused upon zinc electrode performance parameters, high current density discharge evaluation, and low-cost membrane cycle-life performance.

43386 **Mathematical modeling of lithium(alloy), iron disulfide cells.** Bernardi, D.; Newman, J. (General Motors Research Labs., Warren, MI 48090-9055). *Journal of the Electrochemical Society;* **134**: No. 6, 1309-1317(Jun 1987).

Results obtained from computer programs simulating the behavior of LiAl/FeS/sub 2/ and Li(Si)/FeS/sub 2/ high temperature cells employing LiCl-KCl electrolyte are presented. The thermodynamic, open-circuit potential of these cells as a function of state-of-discharge and negative-to-positive capacity ratio is investigated. A nonequilibrium cell model gives the effects of state-of-discharge, initial electrolyte composition, temperature, and discharge current density on cell voltage. Reaction rate distributions are discussed. The model predicts that KCl precipitation can limit the utilization of the FeS/sub 2/ electrode, usually on the lowest voltage plateau. The calculated cell discharge behavior is compared with available experimental data.

43387 **Photoelectrochemistry and electroreflectance of "as-grown" and reduced poly-3-methylthiophene (P3MT) in an aqueous electrolyte.** Ginley, D.S. (Dept. of Physics, Brooklyn College of CUNY, Brooklyn, NY 11210). *Journal of the Electrochemical Society;* **134**: No. 6, 1384-1388(Jun 1987).

Conductive polymers have potential as the active elements in a number of practical devices from batteries to photoelectrochemical devices. Poly-3-methylthiophene (P3MT), because of its considerable air stability, is of particular interest. The authors report on the photoelectrochemical properties and electrolyte electroreflectance spectra (EER) of neutral and doped P3MT films in aqueous electrolytes. The observed p-type photoresponse and direct band transitions are slightly different for neutral and doped materials, and evidence is presented for a transition due to adsorbed methylviologen in the neutral material. Models are discussed for both the photoelectrochemical and EER results.

43388 **Improved Li/SO/sub 2/ reliability using complex impedance analysis.** Jaeger, C.D.; Levy, S.C.; Thomas, E.V. (Sandia National Labs., Albuquerque, NM 87185). pp 93-106 of Proceedings of the symposium on lithium batteries. Dey, A.N. Pennington, NJ; The Electrochemical Society (1986). (CONF-861068—).

From Electrochemical Society fall meeting; San Diego, CA, USA (19 Oct 1986).

As part of a program to develop a methodology for predicting reliability of Li/SO/sub 2/ cells, complex impedance analysis was evaluated and several impedance parameters were identified which are related to cell capacity. Modeling of capacity as a function of these parameters was accomplished using a regression tree. From this a cell screening methodology was developed which could significantly improve reliability.

43389 **New highly conductive inorganic electrolytes: The liquid SO/sub 2/ solvates of the alkali and alkaline earth metal tetrachloroaluminates.** Foster, D.L.; Kuo, H.C.; Schlaikjer, C.R.; Kallianidis, M.; Dey, A.N. (DURACELL INC., Duracell Research Center, 37 A Street, Needham, MA 02194). pp 477-489 of Proceedings of the symposium on lithium batteries. Dey, A.N. Pennington, NJ; The Electrochemical Society (1986). (CONF-861068—).

From Electrochemical Society fall meeting; San Diego, CA, USA (19 Oct 1986).

The liquid SO/sub 2/ solvates of the tetrachloroaluminate of lithium, sodium, calcium and strontium and their mixtures have been found to be very highly conductive inorganic electrolytes with low SO/sub 2/ vapor pressure. The conductivity is as high as 10/sup -1/ohm/sup -1/cm/sup 1/ for some compositions. The addition of the SO/sub 2/ solvate of NaAlCl/sub 4/, Ca(AlCl/sub 4/)/sub 2/ or Sr(AlCl/sub 4/)/sub 2/ to LiAlCl/sub 4/ . 3SO/sub 2/ has been found to lower the freezing point considerably. The lithium stability at elevated temperatures is best in electrolytes with higher SO/sub 2/ contents such as LiAlCl/sub 4/ 6SO/sub 2/ or SO/sub 2/ solvate electrolyte containing NaAlCl/sub 4/ than electrolyte containing pure LiAlCl/sub 4/ 3SO/sub 2/.

43390 **Inorganic electrolyte battery systems with solid positive electrodes.** Kuo, H.C.; Foster, D.L.; Kellianidis, M.; Bowden, W.; Schlaikjer, C.R.; Dey, A.N. (DURACELL INC., Duracell Research Center, 37 A Street, Needham, MA 02194). pp 455-476 of Proceedings of the symposium on lithium batteries. Dey, A.N. Pennington, NJ; The Electrochemical Society (1986). (CONF-861068—).

From Electrochemical Society fall meeting; San Diego, CA, USA (19 Oct 1986).

Inorganic SO/sub 2/ electrolytes have good conductivity and a wide electrochemical window and are suitable for a variety of solid active positive depolarizers. Several positive electrode materials were evaluated. CuCl/sub 2/ has shown the best discharge performance and rechargeability. The Li/CuCl/sub 2/ system with inorganic SO/sub 2/ electrolyte has an OCV of 3.42 V and discharges at two voltage plateaus, one at above 3.0 V and the other at about 2.5 V, with a utilization of 2 eq/mole. The performance of the CuCl/sub 2/ electrode in various SO/sub 2/ electrolytes has been evaluated.

43391 **Discharge and anode film forming reactions in the Li/LiAlCl/sub 4/ . 3SO/sub 2//carbon rechargeable cell.** Schlaikjer, C.R.; Foster, D.L.; Kuo, H.C.; Chow, L.; Dey, A.N. (Duracell Research Center, 37 A Street, Needham, MA 02194). pp 437-454 of Proceedings of the symposium on lithium batteries. Dey, A.N. Pennington, NJ; The Electrochemical Society (1986). (CONF-861068—).

From Electrochemical Society fall meeting; San Diego, CA, USA (19 Oct 1986).

The open circuit potential of the reversible reduction of LiAlCl/sub 4/ . 3SO/sub 2/ on carbon is 3.2 V vs. lithium at ambient temperature, over 250 mV more anodic than the sulfur dioxide/lithium dithionite couple. Analysis of carbon electrodes discharged against lithium in LiAlCl/sub 4/ . 3SO/sub 2/ revealed only crystalline lithium chloride, while aluminum and S/sup 111/ were present in amorphous form. The stoichiometry and the physical properties of discharged carbon electrodes suggested that the sulfur containing product was the insoluble lithium salt of a complex between aluminum, reduced sulfur dioxide, and the carbon surface.

43392 **Rechargeable Li/SO/sub 2/ system with inorganic electrolyte.** Kuo, H.C.; Schlaikjer, C.R.; Foster, D.L.; Kallianidis, M.; Dey, A.N. (DURACELL INC., Duracell Research Center, 37 A Street, Needham, MA 02194). pp 414-436 of Proceedings of the symposium on lithium batteries. Dey, A.N. Pennington, NJ; The Electrochemical Society (1986). (CONF-861068—).

From Electrochemical Society fall meeting; San Diego, CA, USA (19 Oct 1986).

The ambient temperature Li/SO/sub 2/ rechargeable system with porous carbon positive electrode and the highly conductive LiAlCl/sub 4/ -xSO/sub 2/ electrolyte was investigated. The system operates at a nominal voltage of 3.2 V. It has good rechargeability and rate capability. The discharge performance depends on the type of carbon used for the positive electrode. An energy density of about 100 Wh/kg is realized in prototype 2/3A size wound cells. The system is capable of taking overcharge.

43393 **A new positive electrode material based on Li/sub 4/Mo/sub 5/O/sub 12/.** Huang, C.K.; Crouch-Baker, S.; Huggins, R.A. (Dept. of Materials Science and Engineering, Stanford Univ., Stanford, CA 94305). pp 409-413 of Proceedings of the symposium on lithium batteries. Dey, A.N. Pennington, NJ; The Electrochemical Society (1986). (CONF-861068—).

From Electrochemical Society fall meeting; San Diego, CA, USA (19 Oct 1986).

This paper describes the electrochemical properties of MoO/sub 2/-rich Li/sub 4/Mo/sub 5/O/sub 12/ when used as a positive electrode material in a non-aqueous lithium cell. It is demonstrated that MoO/sub 2/-rich Li/sub 4/Mo/sub 5/O/sub 12/ has improved electrochemical properties compared with stoichiometric Li/sub 4/Mo/sub 5/O/sub 12/.

43394 **The electrochemical properties of several Li-Mo-O ternary phases.** Huang, C.K.; Crouch-Baker, S.; Huggins, R.A. (Dept. of Materials Science and Engineering, Stanford Univ., Stanford, CA 94305). pp 402-408 of Proceedings of the symposium on lithium batteries. Dey, A.N. Pennington, NJ; The Electrochemical Society (1986). (CONF-861068—).

From Electrochemical Society fall meeting; San Diego, CA, USA (19 Oct 1986).

Three Li-Mo-O ternary phases are known which contain Mo in oxidation state IV, namely Li/sub 4/Mo/sub 5/O/sub 12/, Li/sub 2/MoO/sub 3/, and Li/sub 6/Mo/sub 2/O/sub 7/. Powder X-ray diffraction studies have shown all three materials to have structures similar to that of Li/sub 2/SnO/sub 3/. This paper describes the electrochemical properties of Li/sub 4/Mo/sub 5/O/sub 12/, Li/sub 2/MoO/sub 3/, and Li/sub 6/Mo/sub 2/O/sub 7/ when used as positive electrode materials in non-aqueous lithium cells at room temperature.

43395 **Electrochemical studies of the ternary Li-Si-S system.** Liaw, B.Y.; Ahn, B.T.; Huggins, R.A. (Dept. of Materials Science and Engineering, Stanford Univ., Stanford, CA 94305). pp 393-401 of Proceedings of the symposium on lithium batteries. Dey, A.N. Pennington, NJ; The Electrochemical Society (1986). (CONF-861068—).

From Electrochemical Society fall meeting; San Diego, CA, USA (19 Oct 1986).

Glassy materials based on the Li/sub 2/S-SiS/sub 2/ system have been shown to be among the best lithium solid electrolytes. Ionic conductivities as high as 5x10/sup -4/(Ωcm)/sup -1/ at room temperature have been reported. In this work the Li-Si-S phase diagram is constructed using a combination of powder x-ray diffraction and electrochemical techniques, enabling the stability ranges of materials in the Li/sub 2/S-SiS/sub 2/ system and the Gibbs free energies of formation of Li/sub 2/SiS/sub 3/ and Li/sub 4/SiS/sub 4/ to be determined. The influence of lithium polysulphide, nominally Li/sub 2/S/sub 2/, at the electrode/electrolyte interface is discussed.

43396 **Investigation of the mixed-conducting matrix concept employing a ternary lithium alloy at ambient temperature.** Anani, A.; Crouch-Baker, S.; Huggins, R.A. (Dept. of Materials Science and Engineering, Stanford Univ., Stanford, CA 94305). pp 382-392 of Proceedings of the symposium on lithium batteries. Dey, A.N. Pennington, NJ; The Electrochemical Society (1986). (CONF-861068—).

From Electrochemical Society fall meeting; San Diego, CA, USA (19 Oct 1986).

The concept of an all-solid composite electrode at ambient temperature is explored using the specific example of Li/sub x/Cd($1.5 < x < 2.9$) as the reactant dispersed in a solid mixed-conducting matrix, Li/sub 4.4/Sn. Repeated titration of lithium at potentials determined by the Li/sub x/Cd reactant into and out of the composite material is demonstrated. Only slight polarization is observed during charging and discharging of the composite electrode.

43397 **Measurement of lithium diffusion in several binary lithium alloys at ambient temperature.** Anani, A.; Crouch-Baker, S.; Huggins, R.A. (Dept. of Materials Science and Engineering, Stanford Univ., Stanford, CA 94305). pp 365-381 of Proceedings of the symposium on lithium batteries. Dey, A.N. Pennington, NJ; The Electrochemical Society (1986). (CONF-861068—).

From Electrochemical Society fall meeting; San Diego, CA, USA (19 Oct 1986).

Lithium alloys used as negative electrodes in ambient temperature reversible lithium batteries should have reasonably fast lithium diffusion in order to avoid filamentary and dendritic growths usually associated with pure lithium. In this work, thermodynamic and kinetic parameters for the single phases of nominal composition Li/sub 4.4/Sn, LiCd and LiZn are reported. Chemical diffusion coefficients for these phase are of the order of 10/sup -7/, 10/sup -9/ and 10/sup -9/ cm/sup 2/s/sup -1/, respectively. Their respective thermodynamic enhancement factors, potential stability ranges and lithium self-diffusion coefficients are reported as functions of composition.

43398 **Compatibility of electrodes and electrolytes in lithium systems.** Huggins, R.A. (Dept. of Materials Science and Engineering, Stanford Univ., Stanford, CA 94305). pp 356-364 of Proceedings of the symposium on lithium batteries. Dey, A.N. Pennington, NJ; The Electrochemical Society (1986). (CONF-861068—).

From Electrochemical Society fall meeting; San Diego, CA, USA (19 Oct 1986).

A great deal of attention has been given to the development of lithium-based electrochemical cells in recent years, based upon the expectation of substantial improvements, primarily in specific energy, relative to existing battery systems. Simple calculations show that there are a number of electrode couples that could potentially provide the basis for very attractive cells. However, their development into practical devices has often been retarded by difficulties related to incompatibility between such electrodes and the electrolytes that are used with them, especially when they are to be employed in cycling applications. Thermodynamic aspects of the electrode/electrolyte stability problem are discussed, as well as several alternative approaches that can be considered in order to alleviate such problems. In addition, currently available data on both the span and position of the stability windows of solid and liquid electrolytes of interest for use with lithium-based battery systems are presented.

43399 **Cathodic passivation of Mo in 1.5 M LiAlCl/sub 4//SOCl/sub 2/.** Delnick, F.M.; Cieslak, W.R.; Peebles, D.E.; Rogers, J.W. Jr. (Sandia National Labs., Albuquerque, NM 87185). pp 198-211 of Proceedings of the symposium on lithium batteries. Dey, A.N. Pennington, NJ; The Electrochemical Society (1986). (CONF-861068—). Contract AC04-76DP00789.

From Electrochemical Society fall meeting; San Diego, CA, USA (19 Oct 1986).

Cathodic passivation of Mo in 1.5 M LiAlCl/sub 4//SOCl/sub 2/ is initially limited by Fowler-Nordheim tunnel emission of electrons from the metal to localized states in the LiCl film. After the establishment of a space-charge layer at the Mo/LiCl interface, film growth becomes kinetically limited by impurity (hopping) conduction of electrons through the localized states. A simplified electronic structure of the Mo/LiCl/SOCl/sub 2/ half-cell is presented.

29 ENERGY PLANNING AND POLICY

2901 Energy Analysis And Modeling

REFER ALSO TO CITATION(S) 43431, 43443, 43453, 43455, 43456, 43457, 43460

43400 **(IFP—33-343) Modelization of substituable energy demand. The Translog approach.** Papee, J. (Institut Francais du Petrole (IFP), 92 - Reuil-Malmaison; Ecole Nationale Superieure du Petrole et des Moteurs (ENSPM), 92 - Rueil-Malmaison (France)). Mar 1985. 167p. (In French). NTIS (US Sales Only), PC A08/MF A01. File Number DE87753165.

A synthesis of researches on transcendental logarithmic functions for economic modelization of energy substitutions is presented. The theory is completed by the study of production frontiers and cost. Application to French residential and industrial sectors is not very satisfactory. However it is necessary to develop these theories for a better knowledge of energy consumption for the long term complementing the econometric approach for the short term. The increasing number of data should enlarge the theoretical field using these data for an objective forecasting. 23 refs.

2902 Economics And Sociology

REFER ALSO TO CITATION(S) 42939, 42945, 42987, 43049, 43145, 43196, 43422, 43431, 43454, 43458, 43460, 43461, 43462, 43468, 43494, 44178

43401 (CONF-870564—3) A model to assess the relative impact of policy in transportation energy expenditures. Santini, D.J.; Vyas, A.D. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011435.

From Socioeconomic energy research and analysis conference; Washington, DC, USA (21 May 1987).

The research reported in this paper uses the 1977 and 1983 Nationwide Personal Transportation Study surveys (NPTS's) to estimate the cross-section and time responses of minority and majority households in terms of variations in vehicles held by the household, VMT per household vehicle, 1983 dollar income of the household, education and age of the household head, transit availability to the household, workers and nonworkers per household, and urban vs rural location.

43402 (CONF-871089—2) Information technology in business and education: Social issues and research needs. Quiggins, P.A.; Pfuderer, H.A. (Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville (USA). Dept. of Anthropology). 1987. Contract AC05-84OR21400. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012535.

From American Society for Information Science's annual meeting; Boston, MA, USA (4 Oct 1987).

This paper reviews the ways in which social scientists have studied the impact of information technology on society using examples from the fields of business and education. While there has been much speculation concerning such impacts, there have been few studies of them using observation or experimental design. The study of information technology clearly represents a challenge to social scientists and information specialists alike.

43403 (ECN—87-020) Cost-effectiveness calculations and policy. De Boer, A.A. (Netherlands Energy Research Foundation, Petten). Jan 1987. 34p. (In Dutch). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

This report deals with the significance and the estimation of the value of the methods used for answering the question if a project is cost-effective in comparison with alternative projects. The author describes the used calculation methods, comments briefly on the methods and exemplifies the procedures with some case studies from the Dutch energy sector. 26 refs.

43404 (ESC—41) Small-scale non-industrial energy generation. Sensitivity of the earning power of heat-production options. Van Wees, F.G.; Bais, J.M. (Stichting Energieonderzoek Centrum Nederland, Petten. Energie Studie Centrum). Jun 1987. 151p. (In Dutch). NTIS (US Sales Only), PC A08/MF A01. File Number DE87752776.

A model for economic analysis of heat production options is described. Calculations have been made for the economics of hot water boilers, heat pumps and cogeneration equipment (gas engines) in the Netherlands for the period 1987-1996. Seven levels of heat demand (185, 375, 700, 1300, 2600, 8300 and 16600 kWth) and six economic sectors have been considered: residential buildings, homes for aged persons, hospitals, commercial buildings, small industry and greenhouses. Distinction has been made between two forms of management (for cogeneration): by private or public utilities. A sensitivity analysis has been carried out with respect to fuel prices, delivery to the public grid, price of natural gas for the cogeneration option and investment costs. A data-base on the parameters used is included.

2903 Environment, Health, And Safety

REFER ALSO TO CITATION(S) 43050, 43051, 43084, 43085, 43093, 43106, 43475, 43486, 43491, 43968, 43969, 43974, 43983, 43989, 43991, 43998, 44010, 44033, 44041, 44042, 44059, 44063, 44065, 44066, 44067, 44068, 44069, 44070, 44071, 44072, 44073, 44074, 44075, 44076, 44077, 44078, 44079, 44080, 44081, 44082, 44083, 44084, 44085, 44086, 44087, 44088, 44089, 44090, 44091, 44092, 44093, 44094, 44095, 44096, 44097, 44098, 44099, 44101, 44128, 44129, 44134, 44135, 44137, 44139, 44144, 44152, 44157, 44158, 44159, 44160, 44161, 44162, 44163, 44164, 44165, 44166, 44167, 44168, 44169, 44170, 44171, 44172, 44173, 44174, 44175, 44176, 44177, 44178, 44183, 44190, 44737

43405 (CONF-8610316—) Shaping and protection of man's environment. (Ministerium fuer Umwelt, Raumordnung und Landwirtschaft des Landes Nor:'rhein-Westfalen, Duesseldorf (Germany, F.R.); Verein Deutscher Ingenieure (VDI), Duesseldorf (Germany, F.R.)). 1986. 682p. (In German). NTIS (US Sales Only), PC A99. File Number DE87752961.

From CSR symposium and exhibition concerning the planning and protection of the human environment; Duesseldorf, F.R. Germany (1 Oct 1986).

33 papers were given at the symposium 'The shaping and protection of man's environment' dealing with issues of pollution control policy and energy economy as pursued in Czechoslovakia and in the Federal Republic of Germany. 10 records were entered into the data base.

43406 (K/HS—93-Rev.1) ORGDP [Oak Ridge Gaseous Diffusion Plant] long-range environmental management plan: Executive summary. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Feb 1987. Contract AC05-84OR21400. 284p. NTIS, PC A13/MF A01; 1; GPO Dep. File Number DE87012963.

The purpose is to provide the ORGDP and Energy Systems, DOE-ORO, DOE-Headquarters (DOE-HQ), and their staffs with a comprehensive plan that (1) identifies problem areas of environmental management and proposed funding levels required to maintain compliance, (2) reviews environmental regulations and their applicability to ORGDP, (3) discusses compliance status with these regulations, and (4) explains the strategies and programs formulated to solve environmental problems and keep ORGDP in compliance. The document is designed to help managers make day-to-day decisions concerning environmental management. It is divided into four fundamental areas of environmental management: Air Pollution Control, Water Pollution Control, Solid Waste Management, and Remedial Actions. Specific projects identified for each of the programs are discussed in detail along with problem areas that require additional attention.

43407 (PB—87-192597/XAB) Guidance manual for electroplating and metal-finishing pretreatment standards. Final report. Belefski, M. (Environmental Protection Agency, Washington, DC (USA). Effluent Guidelines Div.). Feb 1984. 74p. (EPA—440/1-84/091G). NTIS, PC A04/MF A01.

This manual provides guidance to Publicly Owned Treatment Works (POTWS) on the application and enforcement of the Categorical Pretreatment Standards for the Electroplating and Metal Finishing Categories. The document is based primarily on two sources: Federal Register notices, which include the official announcements of the Categorical Standards, and the Final Development Documents for Electroplating and Metal Finishing, which provide a summary of the technical support for the regulations. Additional information on the regulations, manufacturing processes, and control technologies can be found in these sources. A listing of the references used in the development of the manual is provided at the end of the document.

43408 (PB—87-193348/XAB) RCRA (Resource Conservation and Recovery Act) personnel training guidance manual for owners or operators of hazardous-waste-management facilities. Draft report . (Aware, Inc., Nashville, TN (USA)). Sep 1980. 93p. NTIS, PC A05/MF A01.

The manual provides guidance to an audience consisting of owners or operators of hazardous waste-management facilities and

also regulatory personnel responsible for facility permitting. Information is provided concerning general training strategies and program design, types of training, training modules pertinent to hazardous-waste management, suggested training module elements, and sources of information.

43409 **(PB—87-198784/XAB) Project for international information exchange on dioxins, furans, and related chemicals.** Kutz, F.W.; Bottimore, D.P. (Versar, Inc., Springfield, VA (USA)). Jun 1987. 9p. NTIS, PC A02/MF A01.

A project promoting the exchange of information on polychlorinated dibenzo-p-dioxins and related chemicals has been initiated on an international basis by the North Atlantic Treaty Organization (NATO). Information being exchanged concerns research and other activities which involve polychlorinated dibenzo-p-dioxins, polychlorinated dibenzofurans, and related chemicals. In addition to the major information exchange objective, secondary objectives include the reduction of research program duplication and the assistance in identification of knowledge voids. NATO-member countries participating are Canada, Denmark, the Federal Republic of Germany, Italy, the Netherlands, Norway, the United Kingdom, and the United States. The project is divided up into three basic working groups: (1) exposure and hazard assessment, (2) technology assessment, (3) management of accidents.

43410 **(PB—87-202040/XAB) Guidance for implementing the RCRA dioxin listing rule.** (Environmental Protection Agency, Washington, DC (USA). Office of Solid Waste and Emergency Response). Aug 1985. 102p. NTIS, PC A06/MF A01.

The document is the production of the U.S. EPA's Dioxin Work Group which was assigned the responsibility of developing implementation guidance for the RCRA/CERCLA response to the final dioxin listing rule. The objective of the plan is to supply the Regions, authorized States, and Headquarters with guidance on implementing the RCRA listing of wastes containing particular chlorinated dibenzo-p-dioxin (CDDs) and chlorinated dibenzofurans (CDFs).

2904 Natural Resources

REFER ALSO TO CITATION(S) 43145, 43146, 43150, 43998

43411 **(PB—87-196556/XAB) Availability of land for mineral exploration and development in north-central Alaska, 1985. Special pub.** Bottge, R.G. (Bureau of Mines, Juneau, AK (USA). Alaska Field Operations Center). 1986. 73p. (BM-SP—2-87). NTIS, PC A04/MF A01.

Library of Congress catalog card No. 86-600300.

The Bureau of Mines is engaged in a program to determine the availability of land for mineral exploration and development in Alaska. Researchers are comparing land availability, based on ownership and Federal and State laws and policies, to the distribution of known mineral deposits and terrains. Six regional studies, consisting of extensive data compilation and analysis using mapping techniques, will cover the State. The study encompassed 54.6 million acres in north-central Alaska. Based on the data collected, the researchers divided the land in the study area into 3 availability categories and 15 subcategories. Much of the land currently classified as unavailable is likely to be reclassified; however, more than half of the unavailable land is Federal land considered to be permanently unavailable to mining.

43412 **(PB—87-201075/XAB) Social feasibility as an alternative approach to water-resource planning.** Hrezo, M.S.; Howe, W.J. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Virginia Water Resources Research Center). Oct 1985. 60p. (VPI-VWRRC-Bull—149). NTIS, PC A04/MF A01.

The research examined the approaches of 31 states to including public participation in water resource planning and reviewed the available literature on the subject in order to evaluate (1) the nature and extent of public participation in this area and (2) the compatibility between citizen involvement techniques and policy types. It found a wide gap between the advice on public participation offered by the literature and current state participation programs. The research suggests that conflict over public participation in water resource planning is due, in part, to confusion over the nature of the policies involved. Based on these findings, two models to bridge the gap by incorporating greater consideration of policy type into water resource planning are offered; (1) Social Feasibility Model and (2) the Political Feasibility Model.

2905 Research, Development, Demonstration, And Commercialization

REFER ALSO TO CITATION(S) 43198, 43423, 43444, 44713

43413 **(DOE/ER—0322) Doctoral scientists and engineers working in energy-related activities, 1985.** (Oak Ridge Associated Universities, Inc., TN (USA); USDOE Office of Energy Research, Washington, DC). May 1987. 89p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87011110.

This report summarizes the responses of doctoral level scientists and engineers to a national survey conducted by the National Academy of Sciences/National Research Council and funded by the National Science Foundation, the US Department of Energy, and other Federal agencies. Data concerning the numbers and characteristics of Ph.D.'s who devoted a significant portion of their professional work to energy- or fuel-related activities are presented for 1985. Historical data from previous survey years are also presented; and, within the context of recent funding, policy, and economic trends, the five-year outlook for energy-related Ph.D. scientists and engineers is examined.

43414 **(LBL-PUB—5198) Technology transfer accomplishments, FY 1986.** (Lawrence Berkeley Lab., CA (USA)). Apr 1987. Contract AC03-76SF00098. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87014074.

This is a list of technology transfer activities that either occurred or were first noted during FY 1986. A few items are updated descriptions of ongoing activities first noted in previous years. The name of the principal LBL researcher or contact person appears after each item.

43415 **(NP—7900896) Florida energy research and development index.** (Florida Energy Research and Development Task Force, Tallahassee (USA)). Jun 1987. 105p. The Governor's Energy Office, The Capitol, Tallahassee, FL 32301. File Number TI87900896.

The Florida Energy Research and Development Index is a reference document for the persons, organizations, and types of energy research occurring in Florida. The 253 entries are grouped into 10 categories: (1) energy conservation; (2) electrical, nuclear, and physics; (3) transportation; (4) biomass; (5) solar; (6) miscellaneous renewable energy; (7) fossil energy; (8) environmental, genetic and chemical; (9) energy economics; and (10) miscellaneous energy research. Preparation of the Florida Energy Research and Development Index is required by s. 377.706, Florida Statutes. This index includes energy research projects that were active during calendar year 1986 or the latter part of 1985.

2906 Nuclear Energy

REFER ALSO TO CITATION(S) 43049, 43050, 43054, 43084, 43085, 43093, 43106, 43116, 43281, 43282, 43283, 43349, 43430

43416 **(NUREG—0750-Vol.25-No.2) Nuclear Regulatory Commission issuances.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Publications Services). Feb 1987. 73p. NTIS, PC A04 - GPO. File Number DE87900895.

This report includes the issuances received during the specified period from the Commission (CLI), the Atomic Safety and Licensing Appeal Boards (ALAB), the Atomic Safety and Licensing Boards (LBP), the Administrative Law Judge (ALJ), the Directors' Decisions (DD), and the Denials of Petitions for Rulemaking (DPRM).

43417 **(SAND—85-6001) ESARDA symposium: Reflections on nonproliferation and safeguards.** Ernemann, A. (Sandia National Labs., Albuquerque, NM (USA); International Atomic Energy Agency, Vienna (Austria)). Jul 1985. Contract AC04-76DP00789. Translation source information not available . 17p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87009040.

Includes original French text.

2908 Waste Heat Utilization

43418 **(ESC-WR—87-04) Economic profitability of cogeneration. The minor role of fuel prices for the Dutch situation.** Van Wees, F.G.; Koenders, N.J. (Stichting Energieonderzoek Centrum Nederland, Petten. Energie Studie Centrum). Jun 1987. 16p. Energie Studie Centrum ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

One of the main reasons to invest in options for cogeneration is the expected economic profitability; not only for the present price levels but also for these levels in the future. The results of economic analysis show the relative independence of the economic profitability and fuel prices for natural gas fired cogeneration. This conclusion is due to the relation between fuel prices and the price for electricity in the Netherlands. The impact of other factors like the level of electricity prices, rate of delivery to the public grid, running hours and investment cost, will also be discussed. 7 figs., 1 tab.

2910 Conservation

REFER ALSO TO CITATION(S) 43443, 43454, 43455, 43456, 43458, 43460, 43461, 43462

43419 **(DOE/MA—0305) Annual report on in-house energy management, FY 1986.** (USDOE Assistant Secretary for Management and Administration, Washington, DC. Office of Project and Facilities Management). Jun 1987. 51p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87012898.

This Annual Report addresses program activities during FY 1986, measures accomplishments against the goals in the ten-year plan, and briefly summarizes total program achievements.

2920 Supply, Demand, And Forecasting

REFER ALSO TO CITATION(S) 43004, 43005, 43145, 43430

43420 **(DOE/EIA—0202(87/3Q)) Short-term energy outlook: Quarterly projections, July 1987.** (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). 7 Aug 1987. 53p. NTIS, PC A04/MF A01 - GPO; 1; GPO Dep. File Number DE87013432.

The forecasts are produced using the Short-Term Integrated Forecasting System (STIFS). The STIFS model uses two principal driving variables: a macroeconomic forecast and world oil price assumptions. Macroeconomic forecasts produced by Data Resources, Inc. (DRI), are adjusted by EIA to reflect EIA assumptions about the world price of crude oil, which differ from DRI estimates. EIA's Oil Market Simulation Model is used to project world oil prices. (These models are available on tape from the National Energy Information Center.) The three projections for petroleum supply and demand are based on low, middle, and high crude oil price trajectories. The discussion and tables in this volume refer primarily to the middle, or base case, scenario and, unless otherwise noted, to the domestic situation. Other cases examining the sensitivity of total petroleum demand to varying assumptions about prices, weather, and economic activity are shown in Table 13 on page 51. Discussions of the world oil price refer to the cost of imported crude oil to US refiners.

43421 **(DOE/ET/14692—T19) Peat resource estimation in Minnesota: Final report.** (Minnesota Dept. of Natural Resources, St. Paul (USA). Div. of Minerals). 1987. Contract FG21-79ET14692. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010971.

Results of the DOE peat investigations that were conducted by the Minnesota Department of Natural Resources (DNR) are reported. Objectives were to determine the amount and location of fuel-grade peat that may be harvested and utilized in an environmentally acceptable manner.

43422 **(DOE/PE—0076) Patterns of US energy demand.** Piper, V. (USDOE Assistant Secretary for Policy, Planning and Analysis, Washington, DC. Office of Policy Integration). Aug 1987. 52p. NTIS, PC A04/MF AO1; 1; GPO Dep. File Number DE87014323.

Patterns of US energy use - both current and projected - define an important part of the context in which energy policy decisions are made. This document attempts to provide a policy-oriented overview of US energy use and demand patterns. Specifically, this document: reviews the patterns of US energy use, with emphasis on those aspects that have implications for US energy security; places US energy use and projected demand in a global context, particularly as it relates to a changing world oil market and the dependency of various sectors of the economy on oil; highlights the important interactions between changes in the US economy and changing energy demand; and provides insight into the functioning of energy end-use markets and future energy demand.

2930 Policy, Legislation, And Regulation

REFER ALSO TO CITATION(S) 43051, 43054, 43084, 43085, 43093

43423 **(NP—7900801) Alberta energy: Annual report, March 31, 1986.** Webber, N. (Department of Energy, Mines and Resources, Ottawa, Ontario (Canada)). 31 Mar 1986. 25p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87900801.

Contents include: minister's message; the department; overview of energy developments; policy analysis and planning; mineral resources; scientific and engineering services; Alberta petroleum incentives program; Alberta oil sands equity; mineral revenues; finance and general services; automated information systems; personnel services; internal audit; and financial statements. 15 figs.

2940 Fossil Fuels

REFER ALSO TO CITATION(S) 42939, 42945, 42987, 43004, 43005, 43006, 43401, 43420

2950 Hydrogen And Synthetic Fuels

43424 **Alternate policies for alternate energy sources.** Hall, F.F. (Stanford Linear Accelerator Center (SLAC) Stanford, CA 94305). pp 81-91 of Alternative energy sources VII. Veziroglu, T.N. New York, NY; Hemisphere Publishing (1985). (CONF-851201—). Contract AC03-76SF00515.

From 7. Miami international conference on alternative energy sources; Miami Beach, FL, USA (9 Dec 1985).

Some "alternates within alternates" are studied and possible improvement of our energy policies are explored. The viability of a hydrogen fuel economy is reviewed. Methanol, ethanol or ammonia versus hydrogen is one area of interest. Others include liquid hydrogen versus jet fuels, the use of geothermal, solar, wind or water energy for production of hydrogen gas versus development of deep earth supplies of natural gas is another. Energy enhancement as opposed to energy conservation is investigated with regard to polar climate and what might be done to improve natural energy balances, particularly in the northern hemisphere. Pumping Arctic Ocean water out into the Pacific Ocean via the Bering Strait would be an energy debit as opposed to energy gains such as biomass conversion of future plant growth throughout the Siberian and Canadi-

an tundra regions and presently very arid desert regions, improved access to northern region fuel, metal ore and mineral resources, year-round shipping and fishing fleet operations in the Arctic Ocean and development of the tremendous Greenland hydro-electric power potential.

2960 Electric Power

REFER ALSO TO CITATION(S) 43137, 43430, 43494

43425 **(DOE/EIA—0095(86)) Inventory of power plants in the United States, 1986.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). 11 Aug 1987. 293p. NTIS, PC A13/MF A01 - GPO; 1; GPO Dep. File Number DE87014029.

This document presents information about electric generating units operated by or planned to be operated by electric utilities in the United States and Puerto Rico. It presents statistics about electric generating units in operation by electric utilities, and a 10-year outlook of future generating unit additions by electric utilities, as of calendar year ended 1986.

43426 **(DOE/EIA—0226(87/05)) Electric power monthly, May 1987.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). 13 Aug 1987. 48p. NTIS, PC A03/MF A01 - GPO; 1; GPO Dep. File Number DE87014003.

In May 1987, net generation from petroleum-fired units was 8146 gigawatthours, 22 percent lower than in May 1986. The May 1987 net generation level from petroleum-fired units represented 4.0 percent of the total electricity produced (Figure 1). From March 1987 through May 1987, petroleum-fired net generation has been less than the corresponding months in 1986. In March and April 1987, the cost of heavy oil (consisting of fuel oil numbers 4, 5, and 6 and topped crude oil) delivered to electric utilities increased over the same months in 1986. As a result of this rise in the price of petroleum, gas has been substituted for petroleum at some electric utilities, particularly at large generating plants with gas/petroleum capability. May's gas fired net generation level was 6 percent higher than in May 1986 and contributed 11.3 percent of the total electricity for the month. The May 1987 level of gas-fired net generation, 23,248 gigawatthours, was the highest since September 1986 when electric utilities generated 23,457 gigawatthours. Higher gas consumption was due, in part, to the increase in gas-fired generation in California, where electric utilities consume the second-largest quantity of gas for electricity generation in the Nation. Gas-fired net generation in California in May was 4871 gigawatthours, 42 percent more than in May 1986. Texas, the largest consumer of gas reported net generation from gas-fired units at 8966 gigawatthours, more than one-third of the total gas-fired net generation in the Nation. However, electricity generation from gas in this state decreased 9 percent in May 1987 from May 1986. A reason for this decrease was due to two large lignite coal-fired units becoming operable in the latter part of 1986, increasing the State's coal-fired net generation 13 percent in May 1987 over May 1986.

43427 **(DOE/S—0057-H5) Electricity's future in the United States: A chapter from energy security: A report to the President of the United States.** (USDOE, Washington, DC). Mar 1987. 59p. NTIS, PC A04/MF A01; GPO Dep. File Number DE87013098.

This report consists of a series of graphs and accompanying discussions of the future of the electric power industry in the United States. The contents are divided into broad sections entitled (1) Introduction: Electricity is Critical to the Economic Health and Energy Security of the United States; (2) Supply/Demand Analysis: Additional Electricity Supplies Likely to be Needed in the 1990s; and (3) Options Analysis: To Ensure Reliable and Efficient Supplies, All Options Must be Considered and Institutional Problems Demonstrate the Need for Regulatory Reform. (DWL)

43428 **(EPRI-EM—5314) New directions in end-use assessment and forecasting: A guide to EPRI research, 1987.** Ignelzi, P.; Infeld, J. (Pacific Consulting Services, Berkeley, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Mar 1987. 144p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920536.

This Guide To EPRI Research is comprised of two parts, distinguishing between work being done by EPRI in the area of End-Use Assessment and Forecasting (EAF) and the basis for this work. In addition, an Executive Summary is included which provides an overview of the material in this guide. Part I provides a "tour" of the EAF Subprogram and its place within the Demand-Side Planning Program at EPRI, along with a summary of research efforts and products that have been sponsored to date. The most important feature of this part, however, is the presentation of the EAF Action Plan, which contains information on topics and research areas in which work will be sponsored by EPRI over the next five years. Part II describes the evolution of difficulties facing the electric utility industry as a whole (and EAF practitioners in particular). This starts with notable events and trends and continues through to a set of challenges in the EAF area that remain to be met and which the Action Plan is designed to help meet. Greater attention has been given to the first of the two parts, made up of four chapters, each of which focuses on a different aspect of EPRI's research related to EAF. The second part is intended as a supplement to show the basis for the direction of EPRI's EAF activities. The guide has been designed so that each chapter can be read independently, with cross-references to other chapters and supporting information in Part II where appropriate.

43429 **(NP—7900937) Electricity supply assessment '87.** (New York Energy Ofice, Albany (USA). Div. of Policy Analysis and Planning). Aug 1987. 38p. Charles R. Guinn, New York State Energy Office, Agency Building No. 2, Empire State Plaza, Albany, NY 12223-0001. File Number TI87900937.

This report provides a statewide assessment of New York's electricity supply system under two forecasting scenarios. Under a base forecast, statewide capacity shortages are projected to occur in 1997. With a high economic growth forecast, statewide capacity shortages are possible in 1994. An Electricity Options report to be issued in the fall will provide an analysis of the strategies available to meet New York's projected capacity shortages. This report is divided into four major sections. The first section, Review of Assumptions and Methodology, describes the approach used for this analysis and provides an overview of the Starting Point scenario. The Statewide Capacity Assessment is the second major section. This section provides a review of the reserve margins under both forecast scenarios, and examines projected fuel use and costs. A summary of selected environmental measures is also presented. The Transmission Assessment section discusses issues relating to the state's transmission system and its interconnection with neighboring systems. The final section presents the detailed Data Assumptions underlying the analysis presented in the previous sections. 30 figs.

2980 Consumption And Utilization

43430 **(DOE/EIA—0469(86)) Energy facts, 1986.** (USDOE Energy Information Administration, Washington, DC). 2 Jun 1987. 59p. NTIS, PC A04 - GPO. File Number DE87012674.

The data, organized by energy source, cover 1973 through 1986, except for international energy data, which cover 1975 through 1985. Graphs, charts, and illustrations portray trends, shares, and locations of various energy sources and uses. This year's edition of Energy Facts contains additional information on US energy consumption data.

43431 **Minorities and energy: A review of recent findings and a guide to future research.** Throgmorton, J.A.; Bernard, M.J. III. (Argonne National Lab.). pp 7.259-7.280 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—). Contract W-31-109-ENG-38.

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

This report discusses the results oof the research on minority energy consumption and expenditures being conducted by Argonne National Laboratory for the U.S. Department of Energy's Office of Minority Economic Impact. After summarizing what was known about minorities and energy prior to 1982, the paper briefly reviews current research results in the areas of minority residential and transportation energy use patterns, energy policy assessments, and minority energy business development. The results suggest that, when income and location (transportation) or climate (residential) are statistically controlled, black households differ from nonblack households in their ability or willingness to make long-term capital investments in energy-efficient consumer durables (e.g., automobiles and appliances). Two hypotheses to explain these results are proposed, relating to the culture of minority and poverty and structural constraints. Implications of the current results and proposed hypotheses are then briefly discussed.

2990 Unconventional Sources And Power Generation

REFER ALSO TO CITATION(S) 43143, 43145, 43196, 43198

43432 (AFME—83-093) Guide for a posteriori evaluation of renewable energy projects in developing countries. (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1984. 80p. (In French). NTIS (US Sales Only), PC A05/MF A01. File Number DE87753131.

A hand-book for an a-posteriori sociological, technical and economical evaluation of renewable energy systems in developing countries is presented. The different points to be controlled, measured or evaluated are precised: influence and effects of the project on the community behaviour and environment, estimation of the energy resource and technical appraising of the proposed equipment and its operating conditions and control, and evaluation of the real costs of the equipment, operation, maintenance and possible malfunctions.

43433 (PB—87-206314/XAB) Energy plantations in the Republic of the Philippines. Forest Service research paper. Durst, P.B. (Forest Service, Asheville, NC (USA). Southeastern Forest Experiment Station). Jul 1987. 24p. (FSRP-SE—265). NTIS, PC A02/MF A01.

Development and management of plantations to support wood-energy programs have been aggressively promoted in the Philippines since 1979. Over 60,000 hectares of energy plantations have been planted under government-supported programs. The paper documents the problems and accomplishments of these programs and describes plantation establishment, maintenance, protection, growth and yield, harvesting, and wood transport. Research priorities for improving energy-farm operations are also suggested.

30 DIRECT ENERGY CONVERSION

3001 Mhd Generators

43434 (CONF-870664—1) Analysis of diffuser/radiant-boiler interface design: High-velocity particle impact at the back wall of the radiant boiler. Hull, J.R.; Berry, G.F. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 12p. NTIS, PC A02. File Number DE87011448.

From 25. symposium on engineering aspects of magnetohydrodynamics; Bethesda, MD, USA (24 Jun 1987).

Three-dimensional gas flow in MHD diffusers and radiant boilers is modeled numerically. Asymmetric axial flow and transverse flow at the diffuser inlet are both shown to have significant effects on the centerline exit velocity. Flow in the radiant boiler can also affect flow within the diffuser. The calculated centerline gas velocities are used to estimate particle impact velocities at the back wall of the radiant boiler due to a portion of the slag layer being sheared away from the MHD channel walls and entering the gas stream. Results indicate that in conventional designs, impact velocities may be unacceptably high, even with a well-designed diffuser.

43435 (DOE/ET/10815—120) Modeling studies of CFFF [Coal Fired Flow Facility] radiant furnace: Topical report. Lee, J.J.; Lineberry, J.T. (Tennessee Univ., Tullahoma (USA). Space Inst.). Jul 1987. Contract AC02-79ET10815. 34p. (UTSI—87-05). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012966.

Past studies that have been performed at UTSI in modeling of the CFFF radiant furnace are described and summarized. This work has been part of the overall research efforts at UTSI in the development of coal-fired MHD power generation. The radiant furnace is the first major in-line component of the downstream power plant train of this DOE experimental facility. Analytical modeling of the gas dynamics and heat transfer within this component and comparisons formed between theoretical and experimental results have provided a means of gaging its performance and design. Methods developed at UTSI to model the radiant furnace have been tailored to the geometry and other physical aspects of the device. A two dimensional gas dynamic model which utilizes a stream function-vorticity approach to solve the Navier-Stokes equations for compressible, turbulent flows forms the basis for the modeling. This model is capable of treating complex recirculating flows of the type that exist in the CFFF furnace. Various additions and modifications to the basic numerical, gas dynamic model have been incorporated over the course of time to specifically address phenomena that are unique to the furnace. These include coupling of the momentum solution to a fundamental form energy solution which includes all modes of heat transfer, conduction, convection, and radiation. A flux radiative transfer method was developed for this need. In addition, particle dynamics modeling to simulate the trajectories of ash/solids laden flows typical to coal combustion was also incorporated. Other features of the modeling are detailed within this report. 12 refs., 11 figs.

43436 (DOE/ID/01745—T14) Mountain States Energy Division's quarterly technical progress report for April 1 through June 30, 1987. (Mountain States Energy, Inc., Butte, MT (USA)). 1987. Contract AC07-78ID01745. 29p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87014007.

This quarterly technical progress report presents the tasks accomplished at the Component Development and Integration Facility during the third quarter of FY87. Areas of technical progress included: coal system development; seed system development; test bay modification; channel power dissipation and distribution system development; materials testing; combustion characterization measurement; coal-fired combustor (CFC) support; 1A channel refurbishment; arc observation project; test operations and results; data enhancement; and data analysis and modeling.

43437 (MHD-III—83-069) Coal-fired MHD Combustor Development Project: Phase IIIB: Final technical report, 13 January 1982-31 March 1983. (TRW Space and Technology Group, Redondo Beach, CA (USA)). Sep 1986. Contract AC22-84PC70508. 101p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87003845.

Significant achievements of the Phase IIIB effort included the following: (1) MHD power generation from a TRW coal-fired combustor integrated with an Avco MHD generator was demonstrated. Power output of 200 kW for 20 minutes (peak 250 kW) was attained. (2) A valid correlation between conductivity results obtained with a Performance Evaluation Module (PEM) and those measured by the MHD channel was demonstrated. (3) The feasibility of operating the MHD coal combustor under low preheat conditions using a coal-fired vitiator to provide oxidizer temperature boost from nominal 1200 to 2900°F was successfully demonstrated. Operation with the vitiator had no adverse effect on the combustion dynamics of the slagging stage. (4) The effects on performance of variation in coal particle size distribution were determined. While the results showed a decrease in heat loss and carbon carryover with finer coal and a peak in slag recovery with a coal having 46 wt. % of particles smaller than 270 mesh, performance was not as sensitive to coal grind as initially anticipated. (5) Stable combustor operation was demonstrated over a thermal input range of 14.8 to 30.9 MW/sub t/. Semi-empirical correlations were developed to relate heat loss and slag recovery to combustion intensity. The operating point for maximum slag recovery was approximately 22 to

25 MW/sub t/ with a first stage equivalence ratio of about 0.7. Minimum first-stage heat loss (6.02%) was achieved at a 30.2 MW/sub t/ input rate. (6) All detail designs for the 50 MW/sub t/ combustor first stage section, second stage section, batch slag tank, and 2900° oil-fired vitiator were completed and a Critical Design Review was held.

3003 Thermoelectric Generators

REFER ALSO TO CITATION(S) 43274

3004 Thermionic Converters

REFER ALSO TO CITATION(S) 43579

43438 (AD-A—181186/8/XAB) Work function measurements. Swanson, L.W.; Davis, P.R. (Oregon Graduate Center, Beaverton (USA). Dept. of Applied Physics and Electronic Science). 1985. 22p. NTIS, PC A02/MF A01.

Pub. in Methods of Experimental Physics, Vol. 22, 1-22(1985).

The determination of the surface work function is an important part of the overall characterization of a surface. Any change in the chemical or physical state of the surface, such as adsorption or geometric reconstruction, can be observed through a work-function modification. In the case of cathode and related studies, the work function may be the single most important surface parameter to be measured. Methods used for these measurements are discussed here. Most of the discussion is devoted to those techniques that may be used for routine measurements of the work function to complement other surface-analysis methods. Thus, particular attention is given to the thermionic and field emission retarding-potential techniques as well as the capacitor method, which give accurate, reproducible results with experimentally simple arrangements. On the other hand, several other methods are given very little consideration. Diode, magnetron, and surface ionization techniques have limited applicability and are not discussed at all.

3005 Fuel Cells

REFER ALSO TO CITATION(S) 43172

43439 (AD-A—181061/3/XAB) Analysis of fuel-cell power plants for DOD (Department of Defense) applications. Volume 1. Final report, 3 February 1986-31 March 1987. Taylor, R.W.; Sterrett, R.H.; Williams, E.R.; Londos, T.C. (Science Applications International Corp., San Diego, CA (USA). Energy Systems and Conservation Div.). Apr 1987. 102p. NTIS, PC A06/MF A01.

See also Volume 2, AD-A180 585.

The objective of the Air Force Remote Site Fuel Cell Development Program is to demonstrate logistically fueled fuel-cell power plants at a remote site in Alaska in the early 1990s. During 1986, most of the Air Force's Alaskan Air Command's (AAC) Minimally Attended Radar (MAR) sites were converted from less-efficiently designed and operated radar sites. A remotely accessed data acquisition system (DAS) was installed at the Sparrevohn MAR site to collect detailed-site energy-load data. The data were compared with the data collected from the Fort Yukon MAR site instrumented under the previous task order. Additional instrumentation was installed at Fort Yukon to characterize fully the diesel generators and the complete energy system. Problems were encountered with the existing fuel-supply system and electrical instruments at Fort Yukon. The nonintrusive ultrasonic flowmeters used at Sparrevohn proved too sensitive for an installation of this nature.

43440 (BNL—40002) An EXAFS study of pyrolyzed metal macrocyclic electrocatalysts. McBreen, J.; O'Grady, W.E.; Sayers, D.E.; Yang, C.Y.; Pandya, K.I. (Brookhaven National Lab., Upton, NY (USA); North Carolina State Univ., Raleigh (USA). Dept. of Physics; Case Western Reserve Univ., Cleveland, OH (USA). Dept. of Physics). May 1987. Contract AC02-76CH00016. 17p. (CONF-870560—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013314.

From 171. Electrochemical Society meeting; Philadelphia, PA, USA (10 May 1987).

Pyrolysis of iron and cobalt N_4-chelates on carbon greatly improves their electrocatalytic activity and stability for oxygen reduction. The best results have been obtained by pyrolysis of absorbed iron and cobalt tetramethoxyphenyl porphyrins (TMPP) on carbon. A knowledge of the structure of these electrocatalysts could point the way toward the development of low cost substitutes of platinum. This paper reports an EXAFS study of pyrolyzed Fe-TMPP and Co-TMPP on Vulcan XC-72 carbon at several temperatures. Pyrolysis yields a mixture of metal, metal oxides and residual metal maorcycle. The presence of the latter is often masked by the metal and the oxide. Chemical leaching of the material to remove these simplifies spectroscopic studies on the residual macrocycle. In the case of Fe-TMPP EXAFS reveals a residual Fe-N_4 species even for pyrolysis temperatures as high as 1000°C. Residual Co-N_4 species were found for Co-TMPP at temperatures below 800°C. Above 900°C the Co-TMPP is completely reduced to the metal. At intermediate pyrolysis temperatures (600 to 800°C) the pyrolyzed Co-TMPP is hydrophobic in KOH.

43441 (DOE/MC/22046—2371) Anode development for solid oxide fuel cells: Final technical report, September 30, 1985 to December 31, 1986. Singhal, S.C.; Ruka, R.J.; Bauerle, J.E.; Spengler, C.J. (Westinghouse Research and Development Center, Pittsburgh, PA (USA)). Dec 1986. Contract AC21-85MC22046. 144p. NTIS (US Sales Only), PC A07/MF A01; 1; GPO Dep. File Number DE87011136.

The performance of present design solid oxide fuel cells, with and without modification of the anodes with the intent to improve their sulfur tolerance, has been investigated in the presence of sulfur in the fuel. The cell voltage of a state-of-the-art solid oxide fuel cell decreases in the presence of H_2S in the fuel; however, this degradation in cell performance is reversible and the cell voltage recovers fully once sulfur is removed from the fuel. The sulfur tolerance of the cell can be improved by properly impregnating the anode of a solid oxide fuel cell with nickel and samarium-doped cerium oxide, whereas incorporation of cobalt in the anode does not provide any beneficial effect. Also, the degradation in performance, in the presence of sulfur in the fuel, appears to be a function of the anode fabrication process (as well as of the impregnation process) based on comparison of current data with prior experimental results. Recommendations for future work include alternate techniques for fabrication and impregnation of the anode, extended tests, effects of temperature and sulfur content of fuel, and cell evaluation techniques.

43442 (N—87-22310) Regenerative fuel cell study for satellites in GEO orbit. Vandine, L.; Gonzalez-Sanabria, O.; Levy, A. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1987. 8p. (CONF-870804—; NASA-TM—89914; E—3607; NAS—1.15:89914; AIAA—87-9200). NTIS, PC A02/MF A01.

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

The results of a 12 month study to identify high performance regenerative hydrogen-oxygen fuel cell concepts for geosynchronous satellite application are summarized. Emphasis was placed on concepts with the potential for high energy density and passive means for water and heat management to maximize system reliability. Both polymer membrane and alkaline electrolyte fuel cells were considered, with emphasis on the alkaline cell because of its high performance, advanced state of development, and proven ability to operate in a launch and space environment. Three alkaline system concepts were studied. Results indicate that using near term technology energy densities between 46 and 52 watt-hour/lb can be achieved at efficiencies of 55 percent. Using advanced light weight cell construction which was achieved in experimental cells, composite tankage material for the reactant gases and the reversible stack concept, system energy densities of 115 watt-hours/lb can be projected.

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

43443 (LBL—22155) Applied Science Division Energy Analysis Program: Annual report, FY 1986. Cairns, E.J.; Levine, M. (Lawrence Berkeley Lab., CA (USA)). Mar 1987. Contract AC03-76SF00098. 56p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87013957.

The Energy Analysis Program continues to place major emphasis on assessing energy conservation opportunities. The priorities for the Program, as reflected in its research, are: first, energy conservation in buildings, a sector in which significant improvements remain possible and cost-effective; second, assessment of world energy demand, an area of critical importance to an understanding of overall energy policy priorities over time; and third, economic analysis, to gain a rational understanding of how energy policies and programs can more effectively contribute to the well-being of the Nation. Summaries are presented of individual projects in building energy analysis, building energy data, energy conservation policy, and international energy studies.

43444 (PNL—6237) IRM National Reference Series: Japan: An evaluation of government-sponsored energy conservation research and development. Howard, C.D. (Pacific Northwest Lab., Richland, WA (USA)). Jul 1987. Contract AC06-76RL01830. 166p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87013984.

Despite the recent drop in world oil prices, the Japanese government is continuing to stress energy conservation, because Japan relies on imports for 85% of its total energy requirements and virtually 100% of its petroleum. Japan stresses long-term developments and sees conservation as an integral part of its 50- to 100-year transition from fossil fuels to nuclear and renewable sources of energy. The Japanese government is targeting new materials, biotechnology, and electronics technologies as the foundation of Japan's economy in the 21st century. Most government research programs in Japan are governed by aggressive timetables and fixed technical goals and are usually guaranteed funding over a 5- to 10-year period. Of the major energy conservation research programs, the best known is the Moonlight Project, administered by the Ministry of International Trade and Industry (MITI), and oriented towards end-use technologies such as Stirling engines and advanced heat pumps. Parts of MITI's Basic Technologies for Future Industries Program involve research in new materials and bioreactors. The Science and Technology Agency's Exploratory Research in Advanced Technologies (ERATO) Program is also investigating these technologies while emphasizing basic research. Other ministries supporting research related to energy conservation are the Ministry of Education, Science, and Culture and the Ministry of Construction. For 1985, government spending for energy conservation research was at least $50 million. Private sector funding of energy conservation research was $500 million in 1984. A brief outline of major programs and key participants is included for several of the most relevant technologies. An overview of Japan's experience in international scientific collaboration is also included.

3201 Buildings

REFER ALSO TO CITATION(S) 43481, 43481, 43483, 44019, 44020, 44021, 44022

43445 (AD-A—180959/9/XAB) Procedure for measuring building R-values with thermography and heat-flux sensors. Special report. Flanders, S.N. (Army Cold Regions Research and Engineering Lab., Hanover, NH (USA)). Mar 1987. 34p. (CRREL-SR—87-6). NTIS, PC A03/MF A01.

43446 (AFME—83-1857) Microcomputer aided energetic design. Horreing, tertiary activities/energetic computer aided design. Brejon, P.; Calvet, P.; Desgouttes, A.; Neirac, F.; Watremez, G. (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1984. 60p. (In French). NTIS (US Sales Only), PC A04/MF A01. File Number DE87753152.

The CASAMO software program and its extensions is described. This microcomputer program is used for the thermal design of buildings, taking into account the solar energy received by the glazings, and is able to perform calculations of the energy consumption (month, year) of a house, of the monthly energy performance of solar heating systems, and of the thermal confort of the various rooms of a house (exposed or non-exposed to sun irradiation). It is also used to attribute the high performance or solar standard labels in France.

43447 (DOE/BP/11287—6) Process evaluation: Final report. Flynn-Brown, C. (Pacific Power and Light Co., Portland, OR (USA)). Oct 1986. Contract AC79-83BP11287. 121p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87011896.

The Process Evaluation is designed to monitor the implementation of the Hood River Conservation Project from the points of view of the local community, the Project's staff, and the contractors who did the actual weatherization. It is designed to be read in conjunction with the Field Weatherization Logistics Report, which is Project management's summary of the process. The source document for the Process Evaluation is Pacific Power & Light Company's "Hood River Conservation Program Proposal" to the Bonneville Power Administration, dated November 19, 1982. The Proposal describes the planned implementation strategy as of that date. The Process Evaluation compares how the Project was actually implemented to the Proposal.

43448 (DOE/BP/11287—T1) The Hood River Conservation Project: Cooperation and community conservation: Comprehensive report, June 1987. Hirst, E. (Oak Ridge National Lab., TN (USA)). Jun 1987. Contract AC79-83BP11287. 66p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87013805.

The Hood River Conservation Project (HRCP) was intended to test the reasonable upper limits of a residential weatherization program. It was proposed by the Natural Resource Defense Council, funded by the Bonneville Power Administration, and operated by Pacific Power and Light Company in Hood River, Oregon. This five-year, $20 million research and demonstration project installed as many cost-justified energy-conservation measures in as many electrically heated homes in Hood River as possible. The measures were aimed at the building shell to reduce electricity use for space heating and at waterheating efficiency; no heating or water heating equipment was replaced. The Project had two parts. One was the weatherization of Hood River homes. Energy audits were performed and measures were installed between fall 1983 and the end of 1985. The other was the research and supporting data collection, which begun a year before field activity started and continued for more than a year after measures were installed. This research was critical to the Project's success because HRCP was designed to provide information on the appropriate role of Pacific Northwest utilities in securing "conservation resources". This report summarizes both elements. Topics discussed include the background and objectives of HRCP, the Project's design and data resources, implementation and marketing efforts, household participation in the Project, weatherization measures installed, levels and changes in electricity use, Project cost-effectiveness, and several supplemental studies that used HRCP data to address issues beyond the scope of the original Project.

43449 (DOE/CE/63482—T3) Thumbody Enterprises Energy-Related Business Expansion Grant: Final report. (Human Development Commission, Caro, MI (USA)). 1987. Contract FG01-86CE63482. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013404.

Objectives of the Thumbody Enterprises project is to build upon the storm window/door manufacturing operation, and home improvement concept, to achieve the following objectives: research and package energy-related plans for alternative financial support; identify and evaluate expansion potential of existing local agency both in energy and non-energy related ventures; and develop training and technical assistance capabilities in business development.

43450 **(DOE/CE/64856—T1) Innovative financing demonstration project for school districts: Section 1, Innovative methods of financing energy conservation projects.** (Florida Governor's Energy Office, Tallahassee (USA)). [1987]. Contract FG01-84CE64856. 126p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87013913.

Most US school buildings were built before 1970, with very little thought given to energy efficiency. Three criteria for evaluating the innovativeness of financing methods are outside funding, positive cash flow, and accessibility. Six major financing methods are evaluated: bank financing, lease financing, tax-exempt financing, utility financing, joint venture financing, and energy services company financing. Case studies are given in Florida. (DLC)

43451 **(EUR—9996) Movable window insulation. Final report.** Ruyssevelt, P.A.; Littler, J. (Commission of the European Communities, Luxembourg). 1985. 101p. NTIS (US Sales Only), PC A06. File Number DE87753168.

Previous work gave rise to a prototype roller blind comprising: two layers of heat reflecting material, brush nylon top seals, magnetic bottom seals, and EPDM soft rubber side seals which may be open and closed to allow the free movement of the blind. The prototype was submitted to thermal transmittance testing in various configurations and the results indicated that a double layer blind is only marginally more effective than a single layer blind within the sealing system. A patent has been filed on both the single and double layer sealing systems. Production of the single layer blind is expected soon.

43452 **(ORNL/TM—9981) Recommended lighting maintenance practices for Army installations.** Kedl, R.J. (Oak Ridge National Lab., TN (USA)). Aug 1987. Contract AC05-84OR21400. 62p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87014111.

A well-maintained lighting system contributes to workforce efficiency and safety. This report recommends routine lighting maintenance practices (primarily relamping and fixture cleaning) for Army installations. The recommendations are derived from consideration of a comparative economic analysis, current maintenance practices in the military and nonmilitary sectors, and information obtained from industry trade and professional associations. Most common sources of interior and exterior illumination are considered: fluorescent, incandescent, and high-intensity discharge. Recommendations concerning window cleaning and wall and ceiling paint are included.

43453 **Validation of the LBL residential energy model.** McMahon, J.E. (Lawrence Berkeley Lab.). pp 8.161-8.174 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—). Contract AC03-76SF00098.

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

The U.S. Department of Energy (DOE) has used the LBL Residential Energy Model since 1979 to estimate the national impacts of federal minimum efficiency standards for residential appliances (including space conditioning equipment) on consumers' energy consumption and costs. The LBL model combines engineering (appliance costs and efficiencies) and economics (demand elasticities for fuel and efficiency choice, and usage) to simulate future energy consumption by end-use. This paper examines the three forecasts using the model (published in 1980, 1982, and 1983) to quantify, in hindsight, their accuracy. The forecasted variables examined are: efficiency of new appliances and volume of shipments. In many areas, data and methodology changes improved the forecasts. Some problem areas remain. The error of forecasts is composed of inaccuracy in exogenous variables (e.g., expected oil price, or economic growth) and the failure of the model methodology to capture the actual responses to those (or other) variables.

43454 **Tracking consumer attitudes on energy conservation in the Pacific Northwest.** Fang, J.M. (Pacific Northwest Lab.). pp 7.62-7.76 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—). Contract AC06-76RL01830.

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

The purpose of this paper is to present the results of a tracking analysis of the changes in consumer attitudes and behaviors between 1983 and 1985. Consumer understanding and perceptions of energy conservation and other issues are explained first. Results concerning past and potential energy conservation actions, financing, and impacts of energy conservation investments are then presented and a simple scheme of market segmentation is discussed. Some implications of the findings are explored.

43455 **Issues in load shape representation.** Pearson, E.W.; Palmiter, L. (Pacific Northwest Lab., Richland, WA). pp 9.220-9.238 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—). Contract AC06-76RL01830.

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

In this paper, the authors investigate two techniques for generating such representations: two-way analysis to develop a model of hourly total and refrigeration load taken from a single residence; and empirical orthogonal function techniques to represent electrical consumption in a Seattle office building. The advantages and limitations of the resulting models are discussed.

43456 **Commercial building energy use monitoring for utility load research.** Mazzucchi, R.P.; Caldwell, L.E. (Pacific Northwest Lab.). pp 9.186-9.188 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—). Contract AC06-76RL01830.

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

The purpose of this presentation is to describe the protocols developed for one of the largest utility load research exercises in the hopes of achieving inter-comparability with related efforts by others. In order to achieve an adequate understanding of the electrical requirements of buildings in the Pacific Northwest to reliably forecast the need for electrical supplies, the Bonneville Power Administration is sponsoring the End-Use Load and Conservation Assessment Program (ELCAP). This program includes the collection and analysis of hourly and sub-hourly time series measurements of electrical loads according to end-use, functional use zones, and key climatic determinants such as inside temperature and solar flux. The presentation describes the overall structure of the commercial sector studies with respect to the sample design, units of analysis, and classification schemes in order to place the measurements in context. Then a site will be described in some detail to indicate both the process and a site will be described in some detail to indicate both the process and substance of the measurement plans and characteristics surveys. Finally preliminary results of measurements from a group of commercial buildings will be described to demonstrate the power and complexity of end-use measurements for commercial buildings.

43457 **Comparison of four versions of the DOE-2 energy analysis program.** Crawley, D.B.; Taylor, Z.T. (Pacific Northwest Lab.). pp 9.58-9.74 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—). Contract AC06-76RL01830.

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

In the last five years, four new versions of the DOE-2 building energy simulation program have been released on a regular basis by Lawrence Berkeley Laboratory - DOE-2.1, DOE-2.1A, DOE-2.1B, and the most recent, DOE-2.1C. In this paper, the variation in results from these four versions of DOE-2 are compared and contrasted for three example office buildings in five locations in the Tennessee Valley region. Variations in annual total and component building energy performance, and the possible reasons for the variances are discussed. Variation in predicted building and plant peak loads are also shown.

43458 **Undoing uncomfortable summer heat islands can save gigawatts of peak power.** Akbari, H.; Taha, H.; Huang, J.; Rosenfeld, A. (Applied Science Div., Lawrence Berkeley Lab., Univ. of California, Berkeley, CA 94720). pp 2.7-2.22 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—). Contract AC03-76SF00098.

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

The authors discuss the major factors that create the heat island, its magnitude and impact on residential cooling energy use, and mitigation techniques. They then simulate building cooling demand as a function of the heat island intensity. Simple heat island energy balance models are used to predict the changes in dry bulb temperatures that are then used as input to DOE-2 hourly simulations. The DOE-2 results enable them to rank measures for preventing the urban heat island. Their preliminary results indicate that planting trees can save as much as 34, 18, and 44% of residential cooling demand on a hot summer day in Sacramento CA, Phoenix AZ and Los Angeles CA, respectively. The cooling energy savings are 53, 33, and — 0%/sup +/. Direct shading of a house itself yields only 11,6, and 12% savings in peak power in the same locations.

43459 **An end-use approach to building energy analysis using actual lighting energy consumption.** Stoops, J.L.; Gilbride, P. (Pacific Northwest Lab., Richland, WA). pp 9.286-9.287 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—). Contract AC06-76RL01830.

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

Using graphical methods of data analysis, this presentation is focused to the examination of the variation of particular end-use energy consumptions in commercial buildings. The source of the information is early data collected as part of the End-use Load and Conservation Assessment Program (ELCAP) being conducted for Bonneville Power Administration (BPA) by Battelle, Pacific Northwest Laboratory (PNL). The lack of daily variation in hourly lighting profiles over several months in most commercial buildings is particularly noteworthy and is examined in some detail. Variation by daytype, season, and the ranges of variation are explored. The sample sizes at this time are too small to draw conclusions but the strength of the smooth profile argument is clear in the lighting consumption data. In most of the buildings examined to date the lighting profile follows a strong regular daily profile with most variation accountable to the differences in work and non-work days. The three dimensional profiles of daily hourly lighting consumption across days appears to be almost perfectly smooth for some buildings.

43460 **The purchase of energy savings pilot program's role within BPA's commercial buildings program strategy.** Schick, H.; Broillet, R. (Bonneville Power Administration). pp 4.145-4.147 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—).

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

The author discusses how the Bonneville Power Administration (BPA) is conducting a number of activities to encourage energy efficiency in commercial buildings. The activities combine to test design options relating to the elements needed for a successful conservation program. One of these activities is the Purchase of Energy Savings (PES) effort. The PES effort is designed to test private entrepreneurs as deliverers of commercial sector energy savings. These sponsors are responsible for marketing the program to attract participation, auditing commercial building to identify potential energy savings, and coordinating the financing, installation and maintenance of the energy conservation measures on behalf of the building owners. In return, sponsors receive incentive payments from BPA over a number of years based on either estimated or measured energy savings from the building retrofits.

43461 **Financial impacts of energy conservation investment in public housing.** Mills, E.; Ritschard, R.L.; Goldman, C.A. (Lawrence Berkeley Lab., Univ. of California). pp 4.119-4.131 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—). Contract AC03-76SF00098.

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

In this study, the authors examines the relative financial impact on HUD and PHAs of four funding strategies, based on case studies of actual retrofit efforts by two local housing authorities: San Francisco, California and Trenton, New Jersey. The selected retrofits all show significant energy savings. This is not, however, reflected in the financial benefits to each party. Under the present PFS rules, HUD benefits substantially from all four retrofit projects. The local PHA also receives positive economic benefits in two cases, a solar domestic hot water system financed by third party investors and a high-efficiency boiler replacement financed with CIAP funds. In another case, the San Francisco Housing Authority weatherized 1827 apartments with a zero-interest load from the local utility and plans to pay the loan back over eight years out of general operating subsidies. The present value of loan payments ($124/apartment unit) exceed the value of lifetime energy savings ($78/unit); thus the retrofit has an overall negative financial impact on the Authority. The Trenton Housing Authority is adversely affected (-$315/unit) because of ongoing maintenance costs associated with a heating control retrofit which are not reimbursed by HUD. Results indicate that the provisions of the PFS often result in a net loss to the local housing authority, while HUD enjoys substantial benefits. This occurs even for conservation measures with payback periods less than three years; hence the present policy reduces the incentive for PHAs to invest in conservation projects that are very cost effective from the "societal" perspective.

43462 **Energy performance contracting for building operation and retrofit: Lessons from the French experience.** Harris, J.P. (Buildings Energy Data Group, Lawrence Berkeley Lab., Univ. of California). pp 4.79-4.100 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—). Contract AC03-76SF00098.

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

This paper takes a close look at the actual experience with heating service contractors ("exploitants de chauffage") in France, and some possible lessons for the U.S. Direct comparisons between France and the U.S. are made with caution, considering the differences in institutional structure, building ownership patterns, and levels of building energy use and cost. Nonetheless, U.S. policymakers should not the paper's conclusion that French performance contracting has yet to demonstrate, in practice, the advantages claimed for it in theory. The author discusses heating service contracting as practiced in France as much more complicated than assumed by its admirers abroad, and French government intervention in the energy service industry has been far more intensive than any policies contemplated in the U.S. Even so, the French system of performance contracting has not fully overcome the barriers to ret-

rofit investment or to sustained, energy-efficient building operation and management after retrofit.

43463 **Ventilation strategies for different climates.** Feustel, H.E.; Modera, M.P.; Rosenfeld, A.H. pp 342-363 of IAQ '86: Managing indoor air for health and energy conservation. Atlanta, GA; American Society of Heating Refrigeration and Air Cond. (1986). (CONF-860446—).

From Managing indoor air for health and energy conservation; Atlanta, GA, USA (20 Apr 1986).

Until recently, residential ventilation in the United States has been provided by infiltration. In this report we compare natural ventilation (ventilation by infiltration) with several mechanical ventilation strategies and examine the overall energy consumption associated with these strategies in different climatic regions in the U.S. The strategies examined are: natural ventilation, balanced ventilation with an air-to-air heat exchanger, exhaust ventilation without heat recovery, and exhaust ventilation with heat recovery via a heat pump. Two strategies for utilizing the heat pump output for domestic hot water are examined. One heat pump strategy employs exhaust fan reversal to provide space cooling whenever possible during the summer months. A modified TRNSYS residential load model incorporating the LBL infiltration model, an algorithm to calculate effective ventilation, and a modified TRNSYS domestic hot water model are used to simulate the energy consumption associated with each strategy.

43464 **Developing cost curves for conserved energy in new refrigerators and freezers.** Goldstein, D.B.; Miller, P. (Natural Resources Defense Council). pp 1.123-1.139 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—).

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

Energy consumption in refrigerators can be reduced through the application of a number of conservation measures. These measures may be introduced in many different combinations and in varying orders, each of which will result in a different cost of conserved energy. A microcomputer model is constructed which estimates the impact of specified conservation measures on energy consumption and on initial and lifecycle costs. The model is used to develop cost curves with measures ranked in order of increasing marginal cost. Cost curves are developed for three models of refrigerator/freezers and two freezers. They show potential savings of more than 75% of current energy use at costs that compare favorably with current electricity prices. This paper begins with a brief description of the model's structure and the calculation algorithms. Next, the cost curves -- with measures applied in order of increasing marginal cost -- are derived. Measures are described along with their associated incremental first costs, marginal costs of saved energy and net lifecycle cost savings.

43465 **Advanced insulation for appliances.** Potter, T.F.; Christensen, C.B. (Solar Energy Research Institute). pp 1.197-1.202 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—).

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

This paper describes the energy-saving potential of using superior insulation in appliance walls, focusing on reducing energy use in refrigerators. The paper also describes a vacuum insulation concept now under development at the Solar Energy Research Institute (SERI). The heat transfer through the refrigerator shell is discussed and compared to other energy-using components. Alternative methods to reduce conductive and radiative heat transfer are described, including vacuum insulation, which is discussed with incremental strategies. Finally, costs and major balance-of-system modifications possible with superior insulation are briefly discussed, as well as efficiency contributions by other innovative components, such as desiccants and thermoelectric heat pumps that would be possible if shell losses were greatly reduced.

43466 **Domestic hot water consumption in four low-income apartment buildings.** Vine, E.; Diamond, R.; Szydlowski. (Lawrence Berkeley Lab.). pp 1.238-1.250 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—). Contract AC03-76SF00098.

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

Domestic hot water consumption is a major source of energy use in multifamily buildings. In contrast to space heating energy consumption, in which behavioral factors compete with the effect of climate, domestic hot water consumption is highly dependent on behavior. Consequently, knowledge of usage patterns is useful in understanding domestic hot water consumption, whether for calculating baseline usage or for estimating retrofit performance. The author investigated domestic hot water consumption in four apartment buildings (a total of 48 units) managed by San Francisco Public Housing Authority. In each of the buildings, we monitored the performance of the domestic hot water system for six months, and interviewed the residents about their hot water usage patterns. They found the shape of the measured profiles of daily domestic hot water consumption to be different from profiles published in the literature. They constructed a model of household water consumption based on reported behavior, and found occupant-reported water consuming behavior to correspond well with measured data: building differences ranged from -19% (the model underpredicts) to 12% (the model overpredicts), and the average difference was approximately 12%. They found educational status to be the only significant sociodemographic predictor of estimated household hot water consumption.

3202 Transportation

REFER ALSO TO CITATION(S) 42964, 43498, 44714

43467 **(AFME—83-0153) Energetic and environmental aspects of residence change process.** Ygnace, J.L. (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1984. 176p. (In French). NTIS (US Sales Only), PC A09/MF A01. File Number DE87753150.

The aim of this study was to investigate through a multi social population, the relations between the distance from the residential house to the working place and the energy consumption of a family. It is shown how the mobility of a family is affected by its social category and that generally people want to be closer to their working place but also to the shops, recreation aeras, etc... some incitements (low-income house-holds, income-tax reductions, etc...) are proposed to induce families to move house in order to reduce their motor car fuel consumption.

43468 **(PB—87-193496/XAB) Urban initiatives program evaluation. Final report.** (Rice Center, Houston, TX (USA)). Jun 1986. 175p. NTIS, PC A08/MF A01.

The Urban Initiatives Program was announced February 15, 1979 as an Urban Mass Transportation Administration effort for addressing urban economic and development problems, using mass transportation projects as the key components. Some 47 projects in 43 cities were funded. The study examines and evaluates projects in 10 case study cities, ranging in grant amounts from $900,000 to $25 million in cities as small as Burlington, Vermont to the larger cities of Boston, Detroit, Philadelphia, and Pittsburgh. Of the ten projects included here, two are intermodal transfer facilities, three are transit malls, and five are joint development projects.

43469 **(SAND—86-2944C) Stability augmentation for a free flying ducted fan.** White, J.E.; Phelan, J.R. (Sandia National Labs., Albuquerque, NM (USA)). 15 Dec 1986. Contract AC04-76DP00789. 40p. (CONF-870830—4-Draft). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87004522.

From AIAA aerodynamics flight mechanics conference; Monterey, CA, USA (17 Aug 1987).

A control system design for the Marine Corp's AROD (Airborne Remote Operated Device) vehicle is described. The AROD vehicle consists of a single gasoline engine and propeller enclosed in a circular airfoil shroud, with the engine throttle and four control vanes (located just aft of the shroud) providing the necessary control authority. Linear quadratic regulator (LQR) and classical controller synthesis techniques were evaluated, with LQR producing a superior design for the coupled dynamics attitude controller because of the relatively slow response of the quarter-scale model airplane servos used to drive the control vanes. The controller design methodology is explained, and a combination of time responses and singular value analyses are used to evaluate the performance of the control system. Preliminary flight test data confirm the validity of the control system design.

3203 Industry And Agriculture

REFER ALSO TO CITATION(S) 42950, 42960, 42960, 42968, 43127, 43147, 43228, 43462, 43485, 43511, 44043

43470 **(AFME—83-210-6) Rational energy utilization, final report.** Baille, A. (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1984. 100p. (In French). NTIS (US Sales Only), PC A05/MF A01. File Number DE87753154.

A review of several research works concerning conservation and rational utilization of energy in agriculture is presented. The three main topics are: conservation of energy in the greenhouses, conservation of energy in livestock buildings, and study of the energy inputs in cultivated lands. The energetic demands of the various agricultural processes are reviewed in order to improve the energy input management (fuel, electricity, fertilizers, plant protection products, livestock foodstuffs...) of the farm; the different energy conservation systems are evaluated and compared and the effects of those various systems on the biology and agronomy (productivity, quality) are examined.

43471 **(AFME—83-0216) District heating networks.** Salagnac, J.L. (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1984. 85p. (In French). NTIS (US Sales Only), PC A05/MF A01. File Number DE87753153.

A bibliographical review concerning district heating networks research and experience throughout the world has been undertaken in order to identify the technical problems that may remain unsolved. One of these problems is situated on the control/command level: temperature, pression and flow rate. Some research trends (design, computer modelization, controls) are proposed. Thermal performance and heat loss calculations methods for district heating are also described.

43472 **(ANL/CNSV—59) Performance tests of the spirally fluted tube heat exchanger for industrial cogeneration applications.** Panchal, C.B.; France, D.M. (Argonne National Lab., IL (USA)). Mar 1986. Contract W-31109-ENG-38. 79p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87014263.

A new type of spirally fluted tube was tested in a shell-and-tube heat exchanger in both condensing and evaporating service for industrial cogeneration applications. The condensation tests were run with R-114 condensing on the shell side and cooling water in the tubes. The vaporization tests were run with R-114 and R-11 vaporizing on the tube side in upward forced convection and steam condensing on the shell side as the heating medium. The condensation tests were carried out in a heat-duty range of 0.35 to 0.78 MW with coolant velocity rates of 1.5 to 4.5 m/s. The test results show that the spirally fluted tube enhances the condensation coefficient by more than 100% and the single-phase heat-transfer coefficient by about 65%, in addition to a 44% outside-area (63% inside-area) enhancement due to the flutes. The vaporization tests were carried out in a heat-duty range of 0.17 to 0.82 MW with vaporization pressures of 152 to 962 kPa and working-fluid exit conditions of 13% mass quality to 22°C vapor superheat. The test results show that the forced-convective vaporization coefficient is enhanced by more than 80% for R-11 and by 100% for R-114, in addition to an inside-area enhancement of 63%. Moreover, the thermal performance does not suffer degradation for relatively high exit mass qualities.

43473 **(CONF-8704186—) Proceedings of the DOE/Industry Advanced Research and Development Sensor Working Group members meeting, Chicago, Illinois.** Emerson, D.B.; Whitworth, B.A. (Energetics, Inc., Columbia, MD (USA)). 30 Apr 1987. Contract AC05-85CE40741. 213p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE87013939.

From DOE/industry advanced research and development sensor working group members meeting; Chicago, IL, USA (30 Apr 1987).

This pulp and paper sensor program undertakes long-term, high-risk applied development activities to develop sensors for improving the efficiency of energy conversion and utilization systems. This document includes summaries, working group comments, and presentation aids (viewgraphs) for the following sensors: in-situ combustion controller, consistency meter, lignin mass spectrometer, acoustic steam flow meter, on-machine sensors to measure paper mechanical properties, and monitor for electrokinetics and flocculation of paper furnish (colloidal slurries). A caucus report is also given. (DLC)

43474 **(DOE/CE/40746—T1-Add.) Advanced high performance steam systems for industrial cogeneration: Addendum final report.** Duffy, T.E.; Schneider, P.H. (Solar Turbines, Inc., San Diego, CA (USA)). Feb 1987. Contract AC02-85CE40746. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013465.

In the main report, the design of an advanced steam turbine capable of expanding 1500°F steam was presented. It featured a two stage turbine with an overhung rotor, which results in a practical low cost design quite similar to the power turbine on production gas turbine engines. Due to the dynamics of the overhung rotor, the turbine operating speed is between the second and third critical speeds. This requires the turbine to pass through critical speeds during each start up and shut down. A substantial amount of rotor and bearing dynamic analysis was done, and a satisfactory bearing design was established. Proprietary damper type tilt pad journal bearings were used to limit the vibration amplitude to acceptables values when passing through the critical speeds. Although the overhung rotor design is a well damped stable design, a straddle mounted rotor will be considered as an alternative. This addendum report summarizes the straddle mounted turbine design that includes several conservative design features in addition to the straddle-mounted rotor arrangement.

43475 **(PB—87-199709/XAB) Feasibility of tax incentives for purchases of recycling equipment or recycled products.** Sellers, J. (Franklin Associates, Prarie Village, KS (USA)). May 1987. 167p. NTIS, PC A08/MF A01.

Growing quantities of solid waste are becoming more difficult and expensive to dispose of in an environmentally safe way. To help alleviate some of this problem, the possibility of providing tax incentives to Illinois' businesses for using recycled materials and products, and the purchase or lease of recycling equipment are investigated in the report. The report evaluates specific tax-incentive options recommended by Illinois businesses using a combination of theoretical modeling and marketing, financial, and other data compiled on the Illinois recycling industry. The report also presents tax incentive policies tried or proposed in other states; looks at programs or proposals made at other governmental levels, and enumerates non-tax factors potentially influencing the viability of tax-incentives as a mechanism for reducing the solid-waste stream through recycling. The report concludes that, while in theory financial incentives can result in increased recycling, tax incentives are not a cost-effective method of providing financial incentives in Illinois.

43476 **(PNL—6270) Irrigation customer survey procedures and results: Detailed analysis.** Harrer, B.J.; Hattrup, M.P.; Weijo, R.O. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1987. Contract AC06-76RL01830. 94p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87014327.

This report presents the results of analyses of data obtained from telephone and in-person survey of irrigators in the Pacific Northwest region. The telephone survey involved approximately 1250 completed responses from irrigators selected from throughout

the Northwest. The in-person survey, which is documented in this report, involved approximately 250 completed responses from irrigators within public utility districts that obtain electricity for serving irrigation loads from Bonneville.

43477 **The Oak Ridge Model: A case study in waste management trends.** Kendrick, C.M.; Row, T.H. (Oak Ridge National Lab., Oak Ridge, TN). pp 51-54 of Proceedings of the symposia of the division of environmental chemistry of the American Chemical Society. Washington, DC; American Chemical Society (1987). (CONF-870410—).

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

The Oak Ridge Model introduces a comprehensive approach to following and pioneering improvements in waste management. It draws together valuable resources from numerous agencies, organizations, and disciplines to thoroughly assess problems and alternatives and implement solutions. The Model demonstrates the author's ability to implement a progressive waste management system and is applicable not only to the DOE-ORO installations, but to facilities nationwide.

3206 Municipalities And Community Systems

REFER ALSO TO CITATION(S) 43456, 43458, 43462, 43471, 43475, 44043

43478 (CONF-8610316—, pp 24.1-24.13) **Extension of district heating networks.** Siewert, M. 1986. (In German). NTIS (US Sales Only), PC A99. File Number DE87752961.

From CSR symposium and exhibition concerning the planning and protection of the human environment; Duesseldorf, F.R. Germany (1 Oct 1986).

The heat is generated in black-coal-fueled power plants (condensation and backpressure types) and supplied and distributed to the final consumers by district heating utilities in networks of their own. The network in the individual cities is organized according to a strategy of insular supply structure while the generation structure is matched to consumption requirements in a stepwise approach.

43479 **(DOE/CE/26566—T1) The use of vacuum pumps and air blowers for low-cost conversions of steam systems to hot water district heating.** Aalto, P.J.; Cohen, D.S. (Pequod Associates, Inc., Boston, MA (USA)). Jul 1987. Contract FG01-86CE26566. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012669.

This paper reports the results of research on the performance of standard steam radiators using hot, wet air as a heating medium under atmospheric and vacuum conditions. The system operates with an air circulating blower and vacuum pump. Vacuum steam and vapor systems were standard heating systems during the first half of this century, but fell out of favor due to the high maintenance costs associated with maintaining vacuum. This experimental design simulates an intervention technique that maintains performance when the system becomes contaminated by air from leaks. The technique applies to Hot Water District Heating Systems that connect to buildings equipped with steam heating systems. Water heated by the District Heating System is sprayed into an air chamber; air becomes saturated and is blown through the distribution piping by a circulating blower. The test results indicate that this method can maintain system performance at near pure vacuum capacity at temperatures above 150°F (65.6°C), even when there are leaks in the radiators and piping. This method can substantially reduce conversion costs to a Hot Water District Heating System in many older buildings equipped with steam radiators.

43480 **(EPRI-CS—5269) Utilization potential of advanced SO_2 control by-products.** Dawson, G. (ICF Northwest, Richland, WA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jun 1987. 277p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920461.

The purpose of Task 4 of the Advanced SO_2 Control Waste Management Project is to explore utilization opportunities for advanced SO_2 control by-products. The wastes/by-products from atmospheric fluidized bed combustion (AFBC), spray dryer, limestone furnace injection, dry sodium sorbent injection, and advanced coal cleaning processes can have significantly different characteristics than conventional utility waste/by-products. Selected advanced SO_2 control by-product utilization applications will be tested in the laboratory and the utilization applications that appeared feasible based on laboratory test results will then be evaluated for their economic feasibility and market potential. This report presents a summary of the evaluations performed to define the recommended laboratory testing program. These evaluations included: Review of previously published literature on both conventional and advanced SO_2 control by-product utilization; technological evaluation of potential by-product utilization applications based on information in the literature; and a preliminary market assessment based on a comparison with conventional combustion by-product marketability. Based on the conclusions of the literature review and the preliminary market assessment, the most promising utilization alternatives for each advance SO_2 control waste were selected for subsequent utilization testing. Recommended test methods/procedures are provided for evaluation of each waste utilization option.

43481 **(LBL—21597) Financial impacts on utilities of load shape changes: The Nevada Power Company.** Eto, J.; Koomey, J.; McMahon, J.; Chan, P. (Lawrence Berkeley Lab., CA (USA)). Apr 1986. Contract AC03-76SF00098. 68p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87013988.

The goal of this LBL project is to develop tools and procedures that measure the financial impacts of load shape changes on utility ratepayers and society. This application studies the financial impacts of policies that raise the efficiencies of residential appliances. The analysis is based on detailed forecasts of energy use by computer simulation models developed at LBL. These models disaggregate both annual energy use and hourly system electric loads at the end-use level for the residential sector. This detail is essential for calculating production and capacity cost benefits, and tariff-class-specific revenue changes. Avoided costs are calculated independently with a production cost simulation model developed for the Electric Power Research Institute. This report is the technical documentation for the case study of the Nevada Power Company (NPC). It provides the interested reader with the underlying assumptions and modeling procedures used to assess the financial impacts of policies that increase the efficiency of residential appliances.

43482 **(LBL—21598) Financial impacts on utilities of load shape changes: The Texas Utilities Electric Company.** Eto, J.; Koomey, J.; McMahon, J.; Chan, P. (Lawrence Berkeley Lab., CA (USA)). Apr 1986. Contract AC03-76SF00098. 123p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87013987.

The goal of this LBL project is to develop tools and procedures that measure the financial impacts of load shape changes to utility ratepayers and society. This application studies the financial impacts of policies that raise the efficiencies of residential appliances. The analysis is based on detailed forecasts of energy use by computer simulation models developed at LBL. These models disaggregate both annual energy use and hourly system electric loads at the end-use level for the residential sector. This detail is essential for calculating production and capacity cost benefits, and tariff-class specific revenue changes. This report is the technical documentation for our case study of the Texas Power and Light (TP and L) service territory of the Texas Utilities Electric Company (TUEC). It provides the interested reader with the underlying assumptions, modeling procedures, and intermediate results used to assess the financial impacts of policies that increase the efficiency of residential appliances.

43483 **(LBL—22627) Financial impacts on utilities of load shape changes: Thermal integrity measures for residential buildings: Texas Utilities Electric Company and Nevada Power Company.** Eto, J.; Koomey, J.; Pignone, C.; McMahon, J.; Chan, P. (Lawrence Berkeley Lab., CA (USA)). May 1986. Contract AC03-76SF00098. 41p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013986.

The goal of this LBL project is to complement existing work by developing analytical tools that bridge the gap between the measured performance of demand-side activities and their financial evaluation within the framework of traditional electric utility planning practice. The purpose of this study is to demonstrate tools developed at LBL for such an integrated assessment. Specifically reported are results for two utility case studies of the load shape and financial impacts of measures that enhance the thermal integrity of residential buildings. The subjects of the case studies are the residential class of the former Texas Power and Light (TP & L) service territory of the Texas Utilities Electric Company (TUEC) and that of the Nevada Power Company (NPC).

43484 **(PB—87-199626/XAB) Potential emissions of hazardous organic compounds from sewage-sludge incineration.** Mazer, S.L.; Taylor, P.H.; Dellinger, B. (Dayton Univ., OH (USA). Research Inst.). Jun 1987. 146p. NTIS, PC A07/MF A01.

Laboratory thermal-decomposition studies were undertaken to evaluate potential organic emissions from sewage-sludge incinerators. Precisely controlled thermal-decomposition experiments were conducted on sludge spiked with mixtures of hazardous organic compounds, on the mixtures of pure compounds in absence of sludge, and on unspiked sludge. These experiments were conducted using laboratory flow-reactor systems interfaced with a gas chromatograph or gas chromatograph-mass spectrometer for product analysis. Issues which were addressed included the effect of the sludge matrix on the thermal-decomposition behavior of the hazardous sludge contaminants; potential emissions from incineration of contaminated and uncontaminated sludge; the relative contributions of the biomass and the contaminants to mass emissions in sewage sludge incineration; potential emissions due to volatilization of organics from sludge in the drying zones of multiple-hearth incinerators.

43485 **(PB—87-203097/XAB) Treatment of contaminated waste-site runoff at the Seymour Recycling Site, Seymour, Indiana.** Traver, R.P. (Environmental Protection Agency, Cincinnati, OH (USA). Hazardous Waste Engineering Research Lab.). 1985. 12p. (EPA—600/J-85/492). NTIS, PC A02/MF A01.

Pub. in Jnl. of Hazardous Materials, 12, 177-185(1985).

The Environmental Emergency Response Unit (EERU) is the U.S. Environmental Protection Agency's (EPA) hazardous-material-spill response and control organization for situations where the use of complex cleanup equipment and techniques are required. EERU is engaged in the shakedown and field demonstration of protypical equipment and techniques developed under the direction and sponsorship of EPA's Hazardous Waste Engineering Research Laboratory (HWERL). In March 1983, EERU was requested by the EPA Region V On-Scene-Coordinator to provide an on-site water-treatment system at the Seymour Recycling Site, Seymour, Indiana, the largest uncontrolled waste site in the state. The system was to be on-site and operational by April 1983. A few of the limiting factors in choosing a system were speed of mobilization, plus short-term and intermittent use.

43486 **(PB—87-206074/XAB) Municipal-waste combustion study: report to Congress. Final report.** Greene, S. (Radian Corp., Research Triangle Park, NC (USA)). Jun 1987. 172p. NTIS, PC A08/MF A01.

See also PB—87-206082.

This report to Congress is in response to Section 102 of the Hazardous and Solid Waste Amendments (HSWA) of 1984. Section 102 of HSWA requires that the EPA provide a report to Congress describing: (1) the current data and information available on emissions of polychlorinated dibenzo-p-dioxins from resource recovery facilities burning municipal solid waste; (2) any significant risks to human health posed by these emissions; and (3) operating practices appropriate for controlling these emissions. EPA expanded the scope of the report to cover additional pollutants emitted from municipal waste combustors and all available pollution control techniques. The report provides an overview of the entire municipal-waste combustion study and discusses the numbers and types of existing and projected facilities; estimates of emissions; options for controlling emissions; risks from emissions and potential for control; costs; and sampling, analysis, and monitoring of emissions.

43487 **(PB—87-206082/XAB) Municipal-waste-combustion study: emission data base for municipal-waste combustors. Final report.** Schindler, P. (Midwest Research Inst., Raleigh, NC (USA)). Jun 1987. 332p. NTIS, PC A15/MF A01.

See also PB—87-206074, and PB—87-206090.

The report describes an emission data base compiled from test reports for Municipal Waste Combustors (MWCs) in the U.S., Canada, Japan, and Europe. These emission data are presented in a format that allows comparison and analysis in order to identify, to the extent of available data, the emission levels of organic compounds (including polychlorinated dibenzo-p-dioxin (PCDD) and polychlorinated dibenzofuran (PCDF)), metals, acid gases, and criteria pollutants that have been achieved from MWC's on a commercial scale. The available operating conditions and control techniques associated with the lowest emission levels for each pollutant of concern identified.

43488 **(PB—87-206090/XAB) Municipal-waste combustion study: combustion control of organic emissions. Final report.** Kilgroe, J. (Energy and Environmental Research Corp., Irvine, CA (USA)). Jun 1987. 223p. NTIS, PC A10/MF A01.

See also PB—87-206082, and PB—87-206108.

This report discusses the combustion practices expected to result in decreased emissions of organic compounds from municipal-waste combustion facilities. The objectives of the study were: to determine the current state of combustion control of municipal solid waste combustion technology; to formulate a combustion-control strategy based upon best engineering practice that will minimize the emission of trace organics from waste-to-energy plants; to define the research which is necessary to develop and verify this combustion-control strategy. Although the focus of the study was concerned with the best combustion practices that will minimize the emissions of organics, including polychorinated dibenzo (p) dioxin and furans (PCDDs/PCDFs), the interrelationship with other pollutants such as particulate matter, metals, NOx, other organics, and carbon monoxide was also considered. The study focused on the design of new units and the operation and monitoring of new and existing units from the viewpoint of the combustor/boiler subsystem. The report discusses current technologies for mass-burn refuse- derived fuel, and starved-air combustions, and the strategies for achieving improved, combustion from these technologies.

43489 **(PB—87-206108/XAB) Municipal waste combustion study: flue-gas-cleaning technology. Final report.** Bina, T.G.; Sedman, C.B. (Environmental Protection Agency, Washington, DC (USA). Office of Solid Waste and Emergency Response). Jun 1987. 83p. (EPA—503/SW-87/021D). NTIS, PC A05/MF A01.

See also PB—87-206090, and PB—87-206116.

This report discusses post-combustion pollution control systems applicable to municipal waste combustion facilities. It describes each generic control system, design and operating considerations, and control effectiveness on selected pollutants. Control systems are discussed for particulate matter control, gaseous controls, and the more-advanced multipollutant control systems. The report summarizes the effectiveness of the control systems for particulate matter, selected acid gases, selected organic pollutants, and selected trace heavy metals. Since the data from commercial municipal solid-waste incinerators are limited, pilot-plant data were also considered in reporting the control effectiveness of some pollutants. The report also addresses the operation and maintenance of flue-gas-cleaning systems.

43490 **(PB—87-206116/XAB) Municipal waste combustion study: costs of flue-gas-cleaning technologies. Final report.** Johnston, M. (Environmental Protection Agency, Washington, DC (USA). Office of Solid Waste and Emergency Response). Jun 1987. 120p. (EPA—530/SW-87/021E). NTIS, PC A06/MF A01.

See also PB—87-206108, and PB—87-206124.

This report is an assessment of emission-control costs for municipal-waste combustors (MWCs). The details of the cost estimates, including their development, components, and cost premises,

are addressed. A model-plant approach was used in the sizing and costing of the emission control systems. Due to differences in the feed-waste characteristics, combustion parameters, and emissions, separate cost estimates were required for mass burning (MB), modular (MOD), refuse-derived fuel (RDF), and fluid-bed combustion (FBC) type furnaces. Cost estimates were developed for control of particulate matter (PM) emissions only and for control of both acid gas and PM emissions from the MWC model plants. Controlled PM emission levels of 0.03, 0.02, and 0.01 gr/dscf, corrected to 12% CO_2, and 90 and 70% reductions of HC1 and SO2, respectively, were used to develop the control cost estimates. Costs were developed using the cost information received from a number of air-pollution-control-equipment manufacturers.

43491 **(PB—87-206124/XAB) Municipal waste combustion study: sampling and analysis of municipal-waste combustors. Final report.** Johnson, L. (Little (Arthur D.), Inc., Cambridge, MA (USA)). Jun 1987. 130p. NTIS, PC A07/MF A01.

See also PB—87-206116, and PB—87-206140; Portions of this document are not fully legible.

The purpose of the document is to provide guidance on sampling and analysis methods to assist federal, state, and local environmental authorities in reviewing plans for operations and testing of MSW combustors. The sampling and analysis procedures outlined here are intended to represent state-of-the-art methods that may be useful in determining the regulatory compliance status of MSW incineration facilities and in assessing their environmental impacts. These same methods may be useful in research and development programs related to MSW combustion technology, standard setting, etc.

43492 **(PB—87-206140/XAB) Municipal waste combustion study: characterization of the municipal waste-combustion industry. Final report.** Morrison, R. (Radian Corp., Research Triangle Park, NC (USA)). Jun 1987. 97p. NTIS, PC A05/MF A01.

See also PB—87-206124, and PB—87-206157.

This report assesses future trends in MWC use by investigating current and projected levels of municipal-waste generation. In projecting the need for new MWC facilities, attempts were made to define the probable configurations (including emission controls) and locations of future sources. The time frame for the characterization of trends in the MWC industry is generally the present through 1995, with limited data being available for the period to 2000. Included in the analysis of potential MWC growth are: an assessment of the existing and predicted quantities of municipal waste generated nationally; an assessment of the impact of land-disposal programs on MWC demand; an assessment of factors such as pending air emission or solid-waste regulations affecting resource recovery of municipal wastes; and a description of the existing MWC industry and its effect on future growth.

43493 **(PB—87-206157/XAB) Municipal-waste combustion study: recycling of solid waste. Final report.** Cheverly, D. (Radian Corp., Research Triangle Park, NC (USA)). Jun 1987. 65p. NTIS, PC A04/MF A01.

See also PB—87-206140.

In this report, background information on recycling, its status in the United States and abroad, and its technical feasibility are examined. Also, because recycling is expected to be an integral part of a solid-waste management plan that includes combustion, potential effects on combustion of removing materials from the waste are considered. The report is designed to convey a sense of the current status of recycling and its technical feasibility, rather than to embody comprehensive authoritative reference material. Subjects addressed in the report include the current extent of recycling in the United States and in several other countries; feasibility of recycling; methods for separation of materials; information on uses and markets for recovered materials; and questions concerning the effects of recycling activities on combustion processes.

43494 **The role of mainframe computer models in least-cost utility planning.** Pignone, C.; Eto, J.; Kahn, E. (Lawrence Berkeley Lab.). pp 8.185-8.194 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—). Contract AC03-76SF00098.

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

Electric utility companies are increasingly using main frame computer models as their central planning tools. Adoption of modelling represents a response to the complexities that have complicated planning over the last few years. At the same time, the concept of least-cost utility planning is gaining acceptance among regulators and, more slowly, utilities as the guiding principle of planning. The interaction between these two significant changes in industry thinking and methods is described, and two of the leading planning models are evaluated for usefulness as tools in the least-cost planning process. It is argued that for better or worse computer modelling is de facto the industry's chosen road to least-cost planning, and, indeed, no alternative is apparent. Further, regulators and policymakers must adopt comparable modelling capability if useful exchange is to continue in the industry.

3209 Education And Public Relations

43495 **(DOE/CE—0193) Eighth annual report to Congress and the Secretary of Energy on the nationwide Energy Extension Service program.** (USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC. Office of State and Local Assistance Programs). Mar 1987. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013989.

The Board emphasizes that energy is a major factor of our national security, economy, business and our individual lives. Energy conservation, energy efficiency techniques, and the maintenance of our domestic infrastructure for energy production capability are vital to our national energy self-sufficiency, national security, and national debt reduction effort. Education which results in reducing energy use through conservation and energy efficiency should also reduce the nation's dependence on foreign oil imports and consumer dependence on direct fuel assistance payments.

33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

3301 Internal Combustion Engines

REFER ALSO TO CITATION(S) 42977, 43500, 43502, 43992

43496 **(DOE/AL/33183—T3) Multidimensional modeling of convective heat transfer with application to IC engines: Technical progress report.** Jennings, M.J.; Morel, T. (Integral Technologies, Inc., Westmont, IL (USA)). 18 Jun 1987. Contract AC04-86AL33183. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011046.

The objective of this project is to develop a more comprehensive understanding of the convective heat transfer process in complex, unsteady turbulent reacting flows, typical of those which occur in internal combustion engines. The specific area of research is the representation of heat transfer in detailed multi-dimensional Navier-Stokes models, and modeling of turbulent transport mechanisms. The detailed tasks include a review of relevant prior work. Based on this review, and original work done under this contract, several modeling approaches are formulated. The tests are carried out on flow cases which have relevance to engine flows, and for which reliable experimental data exist. The analytical studies lead to the determination of the best modeling approaches to be used for heat transfer simulation in internal combustion engines. Following that, a detailed study is carried out of spatial and temporal heat flux distribution in a representative engine. This is complemented by a parametric study of engine heat transfer dependence on intake flow

details, combustion chamber geometry, engine speed and engine load.

43497 **(PB—87-201364/XAB) Phase 1 testing of Toyota lean-combustion system (methanol). Technical report.** Piotrowski, G.K.; Murrell, J.D. (Environmental Protection Agency, Ann Arbor, MI (USA)). Jan 1987. 27p. (EPA/AA/CTAB—87/02). NTIS, PC A03/MF A01.

The Toyota lean-combustion system methanol is a lean-burn methanol-combustion system designed to maximize fuel economy and driving performance while minimizing pollutant emissions. Testing at the EPA Motor Vehicle Emissions Laboratory indicates that this system allows relatively low emissions of regulated pollutants and aldehydes when operated on either M100 or M85 methanol fuel under transient driving and evaporative emissions test conditions. Total vehicle hydrocarbon emissions appear lower when the vehicle is operated on M100 rather than M85 fuel. Fuel economy is slightly improved when the system is operated on M85 rather than M100 fuel.

3303 Electric-powered Systems

REFER ALSO TO CITATION(S) 43498

3304 Hybrid Systems

43498 **(LA—10933-MS) DOT fuel-cell-powered bus feasibility study: Final report, December 1986.** Murray, H.S.; Huff, J.R.; Roach, J.F.; Thayer, G.R. (Los Alamos National Lab., NM (USA)). Jun 1987. Contract W-7405-ENG-36. 372p. NTIS, PC A16. File Number DE87012705.

The purpose of this study was to evaluate and document the feasibility of powering standard size (40 ft) and small (25 to 30 ft) buses with fuel cells. Present status of fuel cell systems was documented and fuel cell development over the next five years was projected. Preferred propulsion systems consisting of pure fuel cells and fuel cell/battery hybrids were identified. Performance modeling was performed using DOT drive cycles for the standard bus and a Georgetown University route for the small bus. A life cycle cost analysis was performed to determine break-even costs for the fuel cell system compared to conventional diesel-powered buses. It was concluded that a functional, hybrid fuel cell/battery powered bus can be built with currently available technology to meet the requirements of the reduced power DOT drive cycle and, with some lowered top speeds, to meet the Georgetown University route requirements. To break even with a diesel bus, fuel cell and reformer costs should be in the range of $200 to $500/kW. No dollar value was placed on the fuel cell's low air and noise pollution. A future development plan was prepared based on this study.

3306 Vehicle Design Factors

43499 **Apparatus for maintaining stability of mobile land vehicles on sloping terrain.** Biller, C.J.; Johnson, D.D. (to Secretary of Agriculture, Washington, DC). US Patent 4,679,803. 14 Jul 1987. Filed date 27 Jan 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A vehicle is described including a base platform supporting a swing-house assembly for rotation about a first axis generally normal to the platform and a driver tread assembly for propelling the vehicle. The swing-house assembly has an operator's cab, an engine and a boom assembly, and the tread assembly has longitudinal and transverse axes normal to the first axis. An apparatus is disposed between the platform and the tread assembly for changing the center of gravity of the vehicle to stabilize the vehicle during its movement over terrain of varying slope the apparatus comprising: means for translating the base platfcrm relative to the tread assembly along the longitudinal axis, and the translating means including means for pivoting the base platform relative to the tread assembly about the transverse axis.

3307 Emission Control

REFER ALSO TO CITATION(S) 43988, 43992, 43994

43500 **(PB—87-194601/XAB) Interim report on the evaluation of a methanol-fueled LTD Crown Victoria. Technical report.** Piotrowski, G.K.; Heavenrich, R.M.; Bruetsch, R.I.; Cheng, J.P. (Environmental Protection Agency, Ann Arbor, MI (USA)). Mar 1987. 17p. (EPA/AA/CTAB—87/03). NTIS, PC A02/MF A01.

The report describes a project involving the testing of a M85 fuelcycle LTD Crown Victoria at the Motor Vehicle Emission Laboratory on the Federal Test Procedure, Highway, New York City, and evaporative tests. It also includes a comparison to simular data taken at three other laboratories (Ford, Engines and Control Systems, Inc., and the City of New York). The vehicle tested is intended for taxicab fleet service in New York City.

43501 **(PB—87-194650/XAB) Collection of lead-poisoned catalysts in houston. Technical report.** Harvey, C.A. (Southwest Research Inst., San Antonio, TX (USA)). Sep 1986. 41p. NTIS, PC A03/MF A01.

This report describes a project involving the testing of lead-poisoned catalytic converters in the Houston, Texas, area. Five lead-poisoned catalysts were collected from motor vehicles. Various methods to evaluate the conditions of the degraded catalysts included weight and backpressure measurements, and x-ray diffraction to define substrate structure.

43502 **(PB—87-194668/XAB) Vehicle-test results from a small twin-roll electric dynamometer. Technical report.** Thompson, G.; Hutchins, F.P. (Environmental Protection Agency, Ann Arbor, MI (USA)). Apr 1987. 68p. (EPA/AA/SDSB—87/04). NTIS, PC A04/MF A01.

The report investigates vehicle test results from a small twin-roll electric dynamometer. The first objective was to determine the level of equivalency between emissions and fuel-economy test results obtained on a hydrokinetic power-absorbtion unit dynamometer and on the D.C. motor electric dynamometer and to define any differences between them. The second objective was to quantify, if possible, performance advantages of the electric dynamometer. Specifically, it was to investigate the changes in the measured emissions and fuel economy resulting from changes in the shape of the dynamometer road-load force versus velocity curve.

43503 **(PB—87-196481/XAB) Heavy-duty-engine testing report: correlation testing of Cummins NTCC-400. Technical report.** Baines, T.M. (Environmental Protection Agency, Ann Arbor, MI (USA)). Oct 1986. 51p. (EPA/AA/SDSB—87/1). NTIS, PC A04/MF A01.

The report discusses the results of testing the Cummins NTCC-400 heavy-duty diesel engine at the Environmental Protection Agency (EPA) Motor Vehicle Emission Lab. This engine was tested for the purpose of providing correlation data to compare EPA and Cummins laboratories. Also reviewed are six fuel compositions of varying aromaticity to investigate how these paramters influence gaseous and particulate exhaust emissions.

43504 **(PB—87-202891/XAB) Reconciling urban VOC/NOx (volatile organic compounds/NOx) emission inventories with ambient concentration data.** Ching, J.K.S.; Novak, J.H.; Schere, K.L.; Gillani, N.V. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). Jun 1987. 20p. (EPA—600/D-87/199). NTIS, PC A02/MF A01.

A review of the current state of emission inventories of volatile organic compounds (VOC) and NOx data compiled for urban areas in the U.S. is presented. The study reveals great differences in the gross-emission magnitudes when compared with corresponding ambient-air concentration data. The VOC emissions data are, in general, shown to be underestimated by factors exceeding 3 or more for most cities. The aggregated emission from urban areas is determined from measurements of excess crosswind and vertically

integrated pollutant concentration over background in the urban plume just downwind of the emissions area.

3308 Alternative Fuels

REFER ALSO TO CITATION(S) 42977

43505 (CONF-870324—1) Two-phase non-Newtonian hydrodynamic modeling of slurries. Wang, C.S.; Lyczkowski, R.W.; Berry, G.F. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 20p. NTIS, PC A02. File Number DE87011519.

From 12. international conference on slurry technology; New Orleans, LA, USA (30 Mar 1987).

The two-phase hydrodynamic theory of fluid/solid flow has been extended to incorporate the constitutive relationship for power-law non-Newtonian behavior. A model has been developed to predict the spatial and temporal variations in solids and liquid velocities and concentration of non-Newtonian slurries under high shear rates in diesel engine injection systems. Comparisons between the present non-Newtonian two-phase theory and the conventional theory have also been made. Selected results for diesel injection nozzle applications are presented. The results from this model can be used to calculate directly the erosion rates at the nozzle boundaries and the solids loading at the nozzle exit.

35 ARMS CONTROL

REFER ALSO TO CITATION(S) 43667, 43668, 43669

43506 (AD-A—180831/0/XAB) Military space station implications. Study project. Bourne, G.D.; Skirvin, G.D.; Wilson, G.R. (Army War Coll., Carlisle Barracks, PA (USA)). 23 Mar 1987. 186p. NTIS, PC A09/MF A01.

Justifying the relevancy of a Manned Military Space Station (MMSS) and subsequently proposing its deployment to capitalize upon the United States' national security interests is the essence and purpose of this group study project. The MMSS is intended to perform a two-fold purpose: (1) facilitate military peacetime operations while simultaneously supporting and promoting civilian space initiatives; and, (2) act as a force multiplier for space and terrestrial force operations in the event of conventional, theater nuclear, and/or strategic nuclear war. Data to support the future value of the MMSS was obtained from individual and group research using unclassified sources such as professional journals, books, US Air Force Staff College reference material, and information from the US Air Force space coordinating staff in Washington, DC. The importance of space to our future and especially of a MMSS by America's national leaders and its people has yet to be fully appreciated and/or realized. The significance of space and its nexus to the United States' national security has been growing dramatically in importance since the launching of the Sputnik in 1957 by Russian. Space, as the forth dimension, cannot and should not be understated in importance as it relates to commercialism, deterrence to war, and to the stability of world order.

3503 Verification

REFER ALSO TO CITATION(S) 43111

36 MATERIALS

REFER ALSO TO CITATION(S) 43650, 43652, 43653, 44228, 44794

43507 (CONF-8708115—1) Oak Ridge National Laboratory materials highlights. Weir, J.R. Jr. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012934.

From 39. technology transfer conference; Nashville, TN, USA (6 Aug 1987).

These 1-page highlights cover: iron and nickel aluminides, whisker-reinforced ceramic composites, joining ceramics, fiber-reinforced SiC ceramic composites, two-phase ceramic coatings, titanium diboride, fabrication of high-field zinc-oxide varistors by sol-gel processing, zirconia-bonded zirconia fiber insulation, pulsed eddy-current NDE, and Sigmajig (hot-cracking test).

43508 (DOE/ER/13335—2) The development of a friction model predicting the sliding behavior of materials pairs, especially at low temperatures: Progress report and renewal proposal. Iwasa, Yukikazu; Rabinowicz, E. (Massachusetts Inst. of Tech., Cambridge (USA)). 9 Mar 1987. Contract FG02-85ER13335. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013941.

Principal objective of this renewal proposal is to develop a friction model which predicts whether a sliding system will give steady or unsteady sliding behavior at low speeds and to advance the basic understanding of the friction process. The proposed program consists of experimental and analytical studies. Experimental work will include collecting data on the material properties of the two contacting materials, namely the bulk creep behavior in tension and interfacial creep data in shear. These data will be collected both at room temperature, and at cryogenic temperatures. Interfacial creep takes place when one material is pressed against the other by a constant force and a shear force insufficient to cause gross sliding is applied. The extent to which the bulk creep properties affect the interfacial creep behavior will be determined, and this knowledge will lead to better models of the friction process.

43509 (DOE/ER/45133—3) Study of multicomponent diffusion and transport phenomena: Annual technical report, July 1, 1986-June 30, 1987. Sato, H.; Kikuchi, R. (Purdue Univ., Lafayette, IN (USA). School of Materials Engineering). 1987. Contract FG02-84ER45133. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014090.

Research was conducted on the following topics: steady-state demixing in oxides, time evolution of demixing, chemical diffusion in alloys, theory of hopping conduction by the path probability method, percolation efficiency and mixed alkali effect, and superionic transport. (DLC)

43510 (LA-UR—87-2456) Experiments on heavy electron and high T/sub c/ oxide superconductors. Maple, M.B.; Dalichaouch, Y.; Ferreira, J.M.; Hake, R.R.; Lambert, S.E.; Lee, B.W.; Neumeier, J.J.; Torikachvili, M.S.; Yang, K.N.; Zhou, H. (Los Alamos National Lab., NM (USA); California Univ., San Diego, La Jolla (USA); Pernambuco Univ., Recife (Brazil). Dept. de Fisica; Indiana Univ., Bloomington (USA). Dept. of Physics; IBM Almaden Research Center, San Jose, CA (USA)). 1987. Contract W-7405-ENG-36. 16p. (CONF-870682—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013163.

From Workshop on novel mechanisms for superconductivity; Berkeley, CA, USA (22 Jun 1987).

In the first part of this paper, we briefly describe some of our efforts to determine the type of pairing and pairing mechanisms that are associated with the superconductivity of heavy electron materials by means of H/sub c2/(T) measurements in Gd-doped (U/sub 1-x/Th/sub x/)Be_{13} alloys. An account of some of our recent work on the new high T/sub c/ copper oxide superconductors is given in the second part of the paper. 30 refs., 12 figs.

43511 (PNL—6247) Inert Anode/Cathode Program: Fiscal Year 1986 annual report. Brenden, B.B.; Davis, N.C.; Koski, O.H.; Marschman, S.C.; Pool, K.H.; Schilling, C.H.; Windisch, C.F.; Wrona, B.J. (Pacific Northwest Lab., Richland, WA (USA)). Jun 1987. Contract AC06-76RL01830. 210p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE87014260.

Purpose of the program is to develop long-lasting, energy-efficient anodes, cathodes, and ancillary equipment for Hall-Heroult cells used by the aluminum industry. The program is divided into four tasks: Inert Anode Development, Cathode Materials Evaluation, Cathode Bonding Development, and Sensor Development. To devise sensors to control the chemistry of Hall-Heroult cells using stable anodes and cathodes. This report highlights the major FY86 technical accomplishments, which are presented in the following

sections: Management, Materials Development, Materials Evaluation, Thermodynamic Evaluation, Laboratory Cell Tests, Large-Scale Tests, Cathode Materials Evaluation, Cathode Bonding Development, and Sensor Development.

3601 Metals And Alloys

REFER ALSO TO CITATION(S) 43241, 43241, 43248, 43250, 43250, 43251, 43252, 43259, 43259, 43278, 43278, 43290, 43328, 43328, 43331, 43332, 43332, 43333, 43396, 44616, 44618, 44620, 44734, 44742, 44790

43512 (AD-A—181220/5/XAB) Analysis of the Soviet response to the Strategic Defense Initiative (SDI). Student report. Morgan, D.E. (Air Command and Staff Coll., Maxwell AFB, AL (USA)). Apr 1987. 32p. (ACSC—87-1800). NTIS, PC A03/MF A01.

Since President Reagan announced the Strategic Defense Initiative (SDI) in March 1983, the Soviet Union has consistently condemned it. This study examines the Soviet response to SDI and provides an explanation for their response. The study identifies military, political, and economic factors that influence the Soviet response to SDI. The author concludes that the Soviets have a genuine concern about SDI, and they will continue their attempts to stop the SDI program at the arms-control negotiations.

43513 (AD-B—036437/2/XAB) Titanium aluminides for elevated-temperature applications. Final report, 1 MarCH 1977-1 May 1978. Rhodes, C.G.; Hamilton, C.H.; Paton, N.E.; Lange, F.F. (Rockwell International Corp., Thousand Oaks, CA (USA). Science Center). Sep 1978. 124p. (SC—5100.24FR). NTIS, PC A06/MF A01.

Distribution limitation now removed.

This report describes the results of a two-part program studying (1) the effects of Al and Nb and quaternary additions in Ti_3Al base alloys on ductility and strength, and (2) the potential for superplastic forming and diffusion bonding of Ti_3Al-Nb type alloys. The results show that room temperature and elevated temperature ductility is decreased with increasing Al content in the composition range 28 to 40 at.%Al. As Nb content is increased from zero to 12 at.pct., ductility increases markedly up to 6 at.%Nb, followed by a lower rate of improvement beyond 6 at.%Nb. It was concluded that, in the composition range studied (28 to 40 at.%Al and 0 to 12 at.%.Nb), an alloy composition of Ti-28Al-7Nb was optimum as regards room temperature ductility (approximately 1%).

43514 (AD-B—041889/7/XAB) Understanding and exploitation of alloys based on the compound TiAl (gamma phase). Technical report (Final), March 1977-December 1978. Blackburn , M.J.; Smith, M.P. (Pratt and Whitney Aircraft, West Palm Beach, FL (USA). Government Products Div.). May 1979. 85p. (PWA-FR—11249). NTIS, PC A05/MF A01.

Distribution limitation now removed.

Alloys based on the TiAl (Gamma) phase have attractive elevated-temperature properties for gas-turbine applications. However, certain processing and property problems will have to be overcome before such materials are qualified for the projected applications. The work performed addressed two such problem areas. In Phase A, an extensive alloy-development effort was conducted in which the effect of single and multiple elemental additions on the microstructure and mechanical properties of various TiAl base compositions was studied in order to overcome the low ductility at room and intermediate temperature. It was shown that the best balance of tensile ductility and creep-rupture strength is achieved when the aluminum content is about 48 at. %. Two other positive compositional effects were demonstrated. One is the increase in ductility at room and intermediate temperature imparted by vanadium additions; the second, a large increase in creep-rupture strength resulting from the addition of 0.1 percent carbon to a Ti-Al-V base.

43515 (AD-B—059014/1/XAB) Research to conduct an exploratory experimental and analytical investigation of alloys. Interim technical report, May 1977-December 1978. Blackburn, M.J.; Smith, M.P. (Pratt and Whitney Aircraft, West Palm Beach, FL (USA). Government Products Div.). Jun 1981. 59p. (PWA-FR—13465-1). NTIS, PC A04/MF A01.

See also AD-B055 853L; Distribution limitation now removed.

Materials based on the intermetallic phases Ti_3Al (alpha 2) and TiAl (gamma) exhibit several attractive features that make them candidates for gas-turbine-engine applications. Low density, good oxidation resistance and high-temperature strength are such characteristics and could result in substitution for the nickel alloys currently used for components that operate at intermediate temperatures. The overall objectives of this portion of the program are to identify Ti_3Al alloys with properties compatible with gas-turbine applications and to develop preliminary processing and finishing techniques that are needed to make prototype hardware. The Ti-Al-Nb system has been shown to be the best system for alloy development. In this study, higher aluminum contents, at a constant niobium level, have been shown to improve stress-rupture properties at the expense of ductility at low and intermediate temperatures. Additions of zirconium, tin, hafnium or carbon to a Ti-Al-Nb base do not produce improved mechanical properties. Substitution of vanadium for some of the niobium in Ti-25Al-11Nb appears useful in reducing cost and density of the alloys. Lower oxygen content was shown to be one of the most effective means to improve-room temperature ductility.

43516 (BDX—613-3695) Equations for determining CVD tungsten-rhenium alloy composition and plating rate. Klingsporn, P.E. (Allied Corp., Kansas City, MO (USA). Bendix Kansas City Div.). Apr 1987. Contract AC04-76DP00613. 14p. (CONF-871027—19). NTIS, PC A02/MF A01; GPO Dep. File Number DE87008831.

From 172. meeting of the Electrochemical Society; Honolulu, HI, USA (18 Oct 1987).

The composition and plating rate of CVD tungsten-rhenium alloy, formed by hydrogen reduction of a tungsten and rhenium metal hexafluoride gas mixture on a heated substrate, depend on the substrate temperature, hydrogen gas flow, metal fluoride gas flow, and the pressure. An equation was derived that allows the alloy composition to be calculated for any combination of the variables, based on the measured composition for one set of the variables. Also, equations were derived from which the W-Re alloy plating rate can be calculated in terms of the measured rate and composition at one set of the variables, or, in terms of the measured rates at two sets of the variables, without knowledge of the composition. W-Re alloy compositions and plating rates calculated with the equations were compared with experimental data.

43517 (BNL—39985) Polyitaconic acid macromolecule primer for adhesive bonding and corrosion control of aluminum. Sugama, T.; Kukacka, L.E.; Carciello, N. (Brookhaven National Lab., Upton, NY (USA)). May 1987. Contract AC02-76CH00016. 15p. (CONF-8705171—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013306.

From Tri-service corrosion conference; Coloarado Springs, CO, USA (5 May 1987).

When polyitaconic acid (PIA) macromolecules are applied as water-soluble primers in polyurethane (PU) adhesive/aluminum adherend joint systems, they interact preferentially with the hydrated oxide aluminum to form hydrogen bonds, and with the isocyanate groups in the adhesive to yield polymer-to-polymer chemical bonding. This chemical coupling between the adhesive and adherend acts significantly to promote interfacial adhesive bonds. The arrangement of a near monolayer of PIA intermediate film plays a key role in governing the adhesion durability of the joint system and the corrosion resistance of the aluminum upon exposure to corrosive fluids. The bond stability and the corrosion resistance are due primarily to the formation of interfacial reaction products which are less susceptible to hydrolysis.

43518 (CEA-R—5374) Room temperature isotherms for Mo and Ni. Masse, J.L. (CEA Centre d'Etudes de Limeil, 94 - Villeneuve-Saint-Georges (France)). Nov 1986. 74p. (In French). NTIS (US Sales Only), PC A04/MF A01. File Number DE87752205.

Isotherms at room temperature for Mo and Ni are proposed. They are of three types: BIRCH, KEANE and BORN-MIE. The adjustable constants appearing in these isotherms have been determined from experimental quantities at zero pressure. An evaluation

of the limit of (δB/sub T//δP)/sub T/ as P -> ∞, where B/sub T/ is the isothermal bulk modulus, has been also used. These three isotherms obtained for Mo and Ni are compared with isotherms derived from shock-wave data according to the PRIETO's model. There is a good agreement between these and these derived from shock-wave data. The three isotherms proposed for Mo and Ni can be considered as valid until pressures of several B/sub To/, where B/sub To/ is the bulk modulus B/sub T/ at P = o.

43519 **(CONF-870505—4) Erosion research on the US Department of Energy Fossil Energy Materials Program.** Judkins, R.R.; Bradley, R.A. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 7p. NTIS, PC A02. File Number DE87004614.

From 32. international gas turbine conference and exhibition; Anaheim, CA, USA (31 May 1987).

Research projects on the US Department of Energy Fossil Energy Materials Program are investigating the mechanisms of erosion and erosion-corrosion of alloys and cermets used in fossil energy systems. The aim is to obtain an understanding of erosion mechanisms that will provide the basis for the development or modification of alloys and cermets with improved erosion resistance. Projects on this program are outlined. Results of recent research activities are presented, and plans for future research are described.

43520 **(CONF-870847—1) Spin correlations in Au/sub 0.85/Fe/sub 0.15/.** Cable, J.W.; Parette, G.; Tsunoda, Y. (Oak Ridge National Lab., TN (USA); Laboratoire Leon Brillouin, Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France); Osaka Univ., Toyonaka (Japan). Faculty of Science). 1987. Contract AC05-84OR21400. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013540.

From 14. international congress and general assembly of the International Union of Crystallography; Perth, Australia (12 Aug 1987).

Neutron diffuse scattering measurements were used to study the spin correlations in Au-15 at. % Fe. Single-crystal data were obtained in the first Brillouin zone for an [001] orientation at temperatures of 10 K and 295 K. The results indicate free-spins at 295 K with the development of spin correlations below about 200 K. The cross section at 10 K is similar to that observed by x-rays with diffuse streaks in [210] directions and diffuse peaks both at (000) and [1 1/2 0]. Intercomparison of the x-ray and neutron data suggests the presence of atomic short range order consisting of Fe platelets in [420] planes but with some spatial correlation between the platelets. The magnetic short range order can be described by ferromagnetic spin correlations in these partially correlated platelets but with a magnetic correlation length larger than that of the atomic order.

43521 **(CONF-871027—22) Oxidation-sulfidation of nickel aluminide in oxygen-sulfur mixed-gas atmospheres.** Natasan, K. (Argonne National Lab., IL (USA)). May 1987. Contract W-31109-ENG-38. 4p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87011360.

From 172. meeting of the Electrochemical Society; Honolulu, HI, USA (18 Oct 1987).

Continuous weight-change measurements were made on Ni_3Al by a thermogravimetric technique in exposure atmospheres of air, a low-p/sub O_2/ gas mixture, and low-p/sub O_2/ gas mixtures with several levels of sulfur. The air-exposed specimens developed predominantly nickel oxide; the specimen exposed to a low-p/sub O_2/ environment developed an aluminum oxide scale. As the sulfur content of the gas mixture increased, the alumina scale exhibited spallation and the alloy tended to form nickel sulfide as the reaction phase. Results indicated that the sulfidation of nickel aluminide (both bare and preoxidized) was determined by the rate of transport of nickel from the substrate to the gas/alumina scale interface, the mechanical integrity of the oxide scale, and the H_2S concentration in the exposure environment.

43522 **(CONF-871027—27) Electrodeposition of microcrystalline chromium from fused salts.** Vargas, T.; Varma, R.; Brown, A. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011365.

From 172. meeting of the Electrochemical Society; Honolulu, HI, USA (18 Oct 1987).

Chromium can be conveniently electroplated from fused chloride electrolytes. The deposition from LiCl-KCl (eutectic)-$CrCl_2$ melts is known to produce large crystal grains. Large grain size and other problems encountered in the electrodeposition of microcrystalline chromium from fused salt are discussed. The results indicate that combined use of forced electrolyte convection and a nucleating pulse in conjunction with a periodic reverse pulse produces fine-grained deposits.

43523 **(CONF-871027—31) Thermodynamic prediction of sulfide capacities in Na_2O-SiO_2 melts.** Reddy, R.G.; Blander, M.; Chen, B. (Nevada Univ., Reno (USA). Dept. of Chemical and Metallurgical Engineering; Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87011359.

From 172. meeting of the Electrochemical Society; Honolulu, HI, USA (18 Oct 1987).

Sulfide capacities of Na_2O-SiO_2 melts at 1473 and 1623°K were calculated a priori from a model using free energies of formation of Na_2S and Na_2O and the activities of Na_2O in the binary Na_2O-SiO_2 melts. Our calculations are in excellent agreement with available experimental data and appear to be more accurate than currently used empirical predictions of sulfide capacities, based on correlations with optical basicities using Pauling electronegativities.

43524 **(DOE/ER/45025—15) Uniformity of sputter-deposited metallic superlattices.** Boufelfel, A.; Falco, C.M. (Arizona Univ., Tucson (USA)). 1987. Contract AC02-83ER45025. 19p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87012743.

A method is presented which uses a cosine-squared flux distribution from a disk-shaped source to calculate the spatial deposition profiles for films sputtered onto rotating substrates. To compare to this calculation depositions were made by dc sputtering and thicknesses measured by three independent techniques. The measured and calculated profiles were compared at a fixed value of target to substrate distance. The implication of these results for the growth of artificial metallic superlattices is discussed.

43525 **(DOE/ER/45025—18) Fabrication and structure of Mo/Ta superlattices.** Bennett, W.R.; Falco, C.M. (Arizona Univ., Tucson (USA)). 1987. Contract AC02-83ER45025. 31p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87012741.

Mo/Ta superlattices with superlattice wavelengths in the range 20 to 180 A were made by alternately sputtering these components. By feedback control of the sputtering rates and microprocessor control of the substrate rotation the individual layer thicknesses were kept constant to within +-0.3% over the entire sample thickness ~0.5 μm. We describe the use of Rutherford Backscattering Spectrometry (RBS) and a variety of x-ray diffraction techniques to structurally characterize these superlattices.

43526 **(DOE/ER/45094—4) Improvement in high magnetic field behavior of vanadium gallium superconductors by enhancement of spin-orbit scattering: Annual technical progress report.** Tedrow, P.M.; Meservey, R. (Massachusetts Inst. of Tech., Cambridge (USA). Francis Bitter National Magnet Lab.). 17 Jul 1987. Contract FG02-84ER45094. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013513.

In light of the zero-field effect on the transport properties of V_3Ga films, we utilized a simpler sample geometry to investigate why the shape of the critical field curve was not changed by the impurities. Using a refurbished evaporator, we made ultra-thin films of V_3Ga in order to be able to place the high atomic number impurity on the surface. Films less than 10 nm thick were needed for this type of experiment. It was shown that placement of surface

layers of the high atomic number impurities did not change the spin-orbit scattering rate. Renormalization of the spin-susceptibility due to quasiparticle inter- actions was shown to have the same effect on the critical field as that due to spin-orbit scattering. We began to fabricate junctions for spin-polarized tunneling measurements to distinguish between these two perturbations. For such measurements the junctions had to have an Al_2O_3 barrier and Fe counter electrodes. The oxidized amorphous silicon barriers commonly used for tunneling into A15 superconductors have been found to randomize the spins of the tunneling electrons, making them unsuitable for use in spin-polarized experiments. Preliminary results of Fe-Al_2O_3-V_3Ga tunneling suggest that the spin-orbit scattering is actually much smaller than expected as a result of fitting the theory to the critical field data. The electronic g-factor was found to be smaller than 2.

43527 (DOE/ER/45163—8) Focussed multiple scattering in compressed ReO_3. Alberding, N.; Crozier, E.D.; Ingalls, R.; Houser, B. (Simon Fraser Univ., Burnaby, British Columbia (Canada). Dept. of Physics; Washington Univ., Seattle (USA). Dept. of Physics). 1986. Contract FG06-84ER45163. 5p. (CONF-860753—9). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011827.

From International conference on EXAFS and near edge structure; Saumur, France (7 Jul 1986).

ReO_3 is a Perovskite consisting of oxygen-bridged rhenium atoms. The bridging angle can be continuously varied by application of pressure above a phase transition at 5.1 kbar. EXAFS spectra of ReO_3 has been measured as a function of pressure up to 22 kbar. The data are related to the angle-dependent oxygen scattering amplitude, $f_0(\beta,k)$. These experimental results are useful in verifying theoretical calculations and for analyzing other systems in which the bridging angle is unknown.

43528 (DOE/ER/45163—9) High pressure studies of SmSe at 77 K. Bauchspiess, K.R.; Crozier, E.D.; Ingalls, R. (Simon Fraser Univ., Burnaby, British Columbia (Canada). Dept. of Physics; Washington Univ., Seattle (USA). Dept. of Physics). 1986. Contract FG06-84ER45163. 5p. (CONF-860753—10). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011828.

From International conference on EXAFS and near edge structure; Saumur, France (7 Jul 1986).

EXAFS studies with high spatial resolution have been performed at the Se K-edge of SmSe at 77 K and up to 57kbar. An increase in the fluctuation of the Sm-Se bond length of ~0.05 A is observed upon going through the isostructural mixed valent transition which is continuous and begins at 25 kbar. For these measurements a pressure cell was constructed for use at low temperature. It is used in the axial geometry.

43529 (DOE/ER/45274—1) [Thermodynamics and kinetics of phase formation of thin-film metal on gallium arsenide]. Chang, Y.A. (Wisconsin Univ., Madison (USA). Dept. of Metallurgical and Mineral Engineering). 1987. Contract FG02-86ER45274. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013904.

It is proposed to investigate the thermodynamics and kinetics of phase formation for metal films deposited on GaAs. The proposed investigation consists of (1) bulk phase equilibrium determinations of selected Ga-As-M ternaries; (2) bulk diffusion couple measurements of GaAs-M; and (3) thin-film studies of M on GaAs. This proposal summarizes our accomplishments during the first six months of the project and our research plan for the coming year.

43530 (DOE/ER/45285—1) Grain boundary phase equilibria in metallic systems: Progress report for period December 1, 1986-November 30, 1987. Deymier, P.; Campos, V.; Evans, H. (Arizona Univ., Tucson (USA)). Aug 1987. Contract FG02-87ER45285. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014123.

One of the primary objectives of this joint experimental/computational research program on grain boundaries in metals is to reconcile experiments and calculations in this field. Both areas have been so often conducted separately for the sake of easiness that loss of coherency is the recurrent characteristic of research on internal interfaces. We have made progress consistent with the original objectives of the proposal both in the theoretical and experimental areas. On the theoretical side, analytical expressions to generate density dependent interatomic potentials in simple metals have been elaborated. Extension of the constant stress molecular dynamics technique to these volume dependent potentials is underway. The molecular dynamics code has been revised to improve its performances on vectorial processors. On the experimental side, an Electron Beam Float-Zone Refiner has been designed and built. The floating zone method has been selected for the preparation of highly pure Al bicrystals as well as bicrystals doped with Mg. The apparatus is currently under testing. We anticipate actual simulations of bulk and defected metallic systems and preparation of Al bicrystals of controlled misorientation by the end of the current term.

43531 (DOE/ER/45297—1) Metallic superlattices with monolayer modulation. Makous, J.L.; Falco, C.M.; Vaglio, R.; Cucolo, A. (Arizona Univ., Tucson (USA). Dept. of Physics; Salerno Univ. (Italy). Dipartimento di Fisica). 1987. Contract FG02-87ER45297. 3p. (CONF-870873—10). NTIS, PC A02. File Number DE87012724.

From 18. conference on low temperature physics; Kyoto, Japan (20 Aug 1987).

We report the preparation and characterization of sputtered Mo/Ta superlattices where the wavelengths are modulated by integer numbers of atomic monolayers. Resistivity and tunnel junction measurements on Mo/Ta superlattices with wavelengths in the range from 153 atomic planes each of Mo and Ta to the monolayer limit of 1 atomic plane of each are found to be consistent with their structural properties as determined by x-ray analyses. In addition, these results are consistent with earlier studies on the phonon structure of Mo/Ta using Brillouin scattering.

43532 (DOE/ER/45297—2) Superconducting properties of metallic superlattices. Falco, C.M.; Makous, J.L.; Cucolo, A.; Maritato, L.; Vaglio, R. (Arizona Univ., Tucson (USA); Salerno Univ. (Italy). Dipartimento di Fisica). 1987. Contract FG02-87ER45297. 12p. (CONF-870182—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012725.

From 8. winter meeting on low temperature physics; Cuernavaca, Mexico (18 Jan 1987).

The preparation by sputtering of artificial metallic superlattices is described, as are the results of x-ray structural determinations. Tunneling and resistivity measurements on these materials are reported.

43533 (DOE/ER/70294—T2) Irradiation induced precipitation in palladium-base alloys: Final report for the period August 1, 1978-January 31, 1986. Ardell, A.J. (California Univ., Los Angeles (USA). Dept. of Materials Science and Engineering). Apr 1987. Contract AS03-76ER70294. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013708.

In addition to thorough investigations of irradiation induced precipitation (IIP) in several Pd base alloys, exploratory research was undertaken to determine whether crystallization could be induced by irradiation of amorphous alloys. There were thus three main areas of study, i.e., that dealing with the research on IIHP in Ni-Si alloys, that on IIP in Pd base alloys, and that on irradiation of amorphous alloys.

43534 (DOE/NASA/16310—4) Long-time creep behavior of the Nb-1Zr alloy containing carbon. Titran, R.H. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1986. Contract AI03-86SF16310. 14p. (NASA-TM—100142; CONF-861076—8). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013853.

From Fall meeting of the Metallurgical Society of AIME; Orlando, FL, USA (5 Oct 1986).

A preliminary study was conducted to determine the feasibility of using a carbon-modified (0.06 wt %) Nb-1Zr alloy to meet the elevated temperature requirements of advanced space power systems. A Nb-1Zr-0.06C alloy was creep tested at 1350 and 1400°K (approximately 1/2 melting point) and the data compared

to similar results from tests of a Nb-1Zr alloy. The Nb-1Zr-C alloy in the annealed condition (1 hr at 1755°K plus 2 hr at 1475°K) was more than five times stronger than the annealed (1 hr at 1475 K) Nb-1Zr alloy. Aging the Nb-Zr-C alloy for 1000 hr at 1350 or 1400 K drastically reduced the high stress creep strength. However, even in the weakened, aged condition, the strength of the Nb-Zr-C alloy was more than four times that of the Nb-1Zr.

43535 **(EPRI-NP—5345) Fatigue crack propagation of low-alloy steel in a vacuum environment: Final report.** James, L.A. (Westinghouse Hanford Co., Richland, WA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Aug 1987. Contract AC06-76FF02170. 41p. NTIS, PC A03/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303; 1; GPO Dep. File Number DE87013770.

The fatigue-crack propagation (FCP) behavior of ASTM A533-B-1 steel was characterized in vacuo at 288°C. Tests were conducted at two stress ratios: R = 0.05 and R = 0.7. Results of these tests were compared with results from precious studies for the same type of steel tested in an air environment, and FCP rates in vacuo were generally lower than those in air. Stress ratio effects in vacuo were not as great as those in air, and both stress ratio effects and environmental effects are discussed from the standpoint of crack closure concepts.

43536 **(EUR—10593) Evaluation of the high-temperature materials programme of the Joint Research Centre (1980-1985).** Glenny, R.J.E.; Boehm, H.; Gellings, P.J.; Gobin, P.; Lanzavecchia, G.; Nicholaides, C. (Commission of the European Communities, Petten (Netherlands). Joint Nuclear Research Center; Commission of the European Communities, Luxembourg). 1986. 98p. NTIS (US Sales Only), PC A05/MF A01. File Number DE87752209.

This report covers the findings of the external panel of experts set up to evaluate the results of the Community's programme in the field of high-temperature materials (1980-1985), carried out at the Petten establishment of the Joint Research Centre. The evaluation covers the quality and relevance of the research, the usefulness of the results and the role played by the JRC in this field at the European level. The report describes and gives comments on the content, structure and management of the five projects constituting the current programme, outlines the methods and procedures used during the evaluation and gives a number of recommendations pertinent to future activities.

43537 **(INIS-mf—10755) Investigation on hydrogen permeation on heat exchanger materials in conditions of steam coal gasification.** Moellenhoff, H. (Essen Univ. (Gesamthochschule) (Germany, F.R.). Fachbereich 8 - Chemie). 15 Nov 1984. 153p. (In German). NTIS (US Sales Only), PC A08/MF A01. File Number DE87752449.

The permeation of hydrogen through iron-based alloys of different compositions in the temperature range between 700 and 1000/sup 0/C was examined in a laboratory fluidized bed in the conditions of steam/coal gasification. Apart from tests on bright metal samples, measurement in the gasification atmosphere at a maximum pressure of 1 bar were carried out during oxidation of the metal. Experiments in a steam/hydrogen/argon mixture with the same oxidation potential were used for comparison purposes. The hydrogen permeated through the metal sample was taken to a gas chromatograph with argon flushing gas and analyzed there. The investigations on bright steel samples of various composition showed that their permeabilities for hydrogen at temperatures around 900/sup 0/C only differed by a maximum of +- 30%. Effective prevention of permeation is therefore not possible simply by choosing a suitable alloy. If the steels are oxidized during permeation measurements, there is a reduction of the hydrogen permeability by 2 or 3 orders of magnitude due to the oxidation process, both in the steam/coal gasification fluidized bed and in a pure steam/hydrogen/argon mixture.

43538 **(IS-T—1240) Computer calculations of metastable and stable Fe-C-Si phase diagrams from binary thermodynamic properties.** Chueh, Shan-Chang. (Ames Lab., IA (USA)). Aug 1987. Contract W-7405-ENG-82. 79p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87013606.

The metastable and stable phase diagrams of the Fe-C-Si system were to be predicted at temperatures of interest by computer calculations. The calculations were to be based on the thermodynamic properties of the constituent binary systems. These properties include (1) lattice stability parameters which reflect Gibbs free energy differences for a single component phase change, (2) excess Gibbs free energy parameters which characterize the departure from the ideal solution behavior of a given binary system, and (3) Gibbs free energies of formation of known binary compounds. The thermodynamic properties were collected from selected literature. They were then used to calculate the constituent binary phase diagrams and the results were compared with the experimentally determined phase diagrams for evaluating the reliability of the binary data before the ternary phase diagrams were calculated.

43539 **(IS-T—1298) Synthesis and characterization of zirconium-antimony binary and interstitial ternary intermetallic compounds.** Garcia, E. (Ames Lab., IA (USA)). Aug 1987. Contract W-7405-ENG-82. 214p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE87013608.

A family of Zr_5Sb_3Z compounds (Z = C, O, Al, Si, P, S, Fe, Co, Ni, Cu, Zn, Ga, Ge, As, Se) have been synthesized in the Mn_5Si_3 structure. Structural refinements were carried out for the compounds Zr_5Sb_3Al, Zr_5Sb_3Si, Zr_5Sb_3S, Zr_5Sb_3Fe, Zr_5Sb_3(Fe/sub 2/3/In/sub 1/3/). Extended-Hueckel band calculations were carried out on Zr_5Sb_3, Zr_5Sb_3S, and Zr_5Sb_3Fe. A high density of states at the Fermi energy, low lying and strongly bonding ZrSb states in the Zr_5Sb_3 host, and the strong bonding interactions between Zr and the interstitial element, combine to permit the extensive interstitial chemistry observed. The Zr-Sb binary system was reinvestigated. Five new phases were identified: Zr_5Sb_3 (Y_5Bi_3-type), ZrSb/sub 1-x/ (FeSi-type), ZrSb (ZrSb-type), $ZrSb_2$ ($PbCl_2$-type), and Zr_2Sb_3. The structure type of an additional compound was elucidated, Zr_2Sb (La_2Sb-type). The unique structure type for ZrSb was determined by a single crystal x-ray diffraction experiment, and structural refinements were also carried out for Zr_5Sb_3 (Y_5Bi_3 and Mn_5Si_3) and $ZrSb_2$ ($PbCl_2$). Extended-Hueckel band calculations were carried out on the two $ZrSb_2$ structural polymorphs, $PbCl_2$ and $ZrSb_2$ types.

43540 **(IS-T—1315) Heat capacity measurements from 150 mK to 1.5 K on some CeSi/sub x/ metallic alloys.** Klavins, P. (Ames Lab., IA (USA)). Aug 1987. Contract W-7405-ENG-82. 61p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87013598.

A calorimeter is described which was designed to operate in the temperature range 150 mK to 1.5 K. The addenda was constructed with materials that have small heat capacities so that the heat capacity contribution of the addenda was much smaller than that of the sample being measured. A bellows type heat switch was used to cool the sample and a standard heat pulse measurement technique was used to obtain data. The heat capacities of two copper samples were measured in order to test the calorimeter. Deviation from the copper reference equation was observed below 0.45°K. The heat capacities of CeSi/sub 1.850/ and CeSi/sub 1.855/ were measured in the temperature range 150 mK to 1.5 K to determine the nature of their magnetic state. Results indicated that both CeSi/sub 1.850/ and CeSi/sub 1.855/ are nonmagnetic down to 150 mK.

43541 **(JAERI-M—87-068) Investigation on ductile fracture behavior of 3-inch diameter Type 304 stainless steel pipe with a circumferential through-wall crack.** Yasuda, Yuji; Shibata, Katsuyuki; Onizawa, Kunio; Kawamura, Takaichi; Ohba, Toshihiro; Miyazono, Shohachiro. (Japan Atomic Energy Research Inst., Tokyo). May 1987. 124p. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. File Number DE87753016.

At Japan Atomic Energy Research Institute (JAERI), a pipe fracture test program has been conducted as a part of the Leak-Before-Break (LBB) verification research in LWR pressure boundary pipings. In this program, fracture behavior and fracture criteria of the circumferentially cracked pipe have been investigated, using austenitic stainless steel pipes and carbon steel pipes. This report presents a four-point bending test results of 3-inch diameter Type

304 austenitic stainless steel pipes with circumferential through-wall crack at room temperature. Pipe fracture data were obtained from the test in regard to load-loadline displacement, crack extension, crack opening area, and so on. Discussions are performed on the effect of pipe ovalization ratio at maximum load, the application of the net-section collapse criterion, and the effect of initial crack angle, wall-thickness etc. on J-R curve. Furthermore, the crack opening area was estimated by assuming a simple crack model.

43542 **(K/ETAC—17-Pt.1) Boundary layer visualization and mass transfer studies on a rotating electroplating mandrel: Exploratory experimentation and technique development.** Keyes, J.L. Jr.; Capps, G.J.; Johnson, B.L. Sr.; White, C.P. (Oak Ridge Gaseous Diffusion Plant, TN (USA). Enrichment Technology Applications Center). Apr 1987. Contract AC05-84OT21400. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013870.

An electrochemical technique for visualization of the laminar diffusion (concentration) boundary layer on a rotating mandrel is described. This technique utilizes the change in pH near the surface associated with formation of an alkaline solution formed by electrolysis of dilute sodium chloride solution at the rotating cathode. The alkaline boundary layer is made visible by phenolphthalein indicator. Development of a technique suitable for determining mass transfer rates on a rotating mandrel of arbitrary axisymmetric contour is also described. This technique utilizes dissolution of a thin coating of benzoic acid in water and has applicability to modeling of an electroplating process.

43543 **(LA-UR—87-1035) Low temperature deposition by laser induced breakdown in the vapor phase.** Jervis, T.R.; Joyce, E.L. Jr. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 12p. (CONF-871027—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87007509.

From 172. meeting of the Electrochemical Society; Honolulu, HI, USA (18 Oct 1987).

We have developed a new technique for deposition on low temperature substrates driven by laser induced dielectric breakdown of gas phase precursors. Metal films of Ni, Fe, and refractory metal alloys show excellent grain refinement and metastable phase incorporation due to rapid quenching from the gas phase. The technique, including the role of gas phase nucleation and growth in the formation of the films, is described.

43544 **(LA-UR—87-2171) Relation between shock strength and strain-rate plasticity at maximum deviatoric stress.** Tonks, D.L. (Los Alamos National Lab., NM (USA)). 24 Jun 1987. Contract W-7405-ENG-36. 14p. (CONF-870753—15). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011736.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

Using Wallace's analysis for steady weak shocks, this paper establishes for Cu, Ur, and 6061T6Al an approximate relations between the shock strength and the maximum deviatoric stress, tau/sub m/, and plastic strain at tau/sub m/. In addition it is shown that the plastic strain rate is very nearly proportional to the total normal strain rate at tau/sub m/. These results and the universal shock strength/strain rate relation of Swegle and Grady are used to draw conclusions about the general plasticity constitutive relation.

43545 **(LA-UR—87-2571) Formation of amorphous alloys by solid state reactions.** Schwarz, R.B. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 27p. (CONF-870893—3). NTIS, PC A03/MF A01; GPO Dep. File Number DE87013175.

From 6. international conference on rapidly quenched metals; Montreal, Canada (3 Aug 1987).

Amorphous metallic alloys have been traditionally prepared by the rapid solidification of molten alloys. New methods of synthesis have been recently developed which are based on isothermal solid state reactions between pure metals. These are carried out at temperatures that kinetically favor the interdiffusion of the species but precludes the nucleation of intermetallics. Other novel methods of synthesis rely on the mechanical attrition of crystalline alloy powders. The paper reviews the basic concepts behind the novel methods of synthesis and compares the amorphous alloys prepared by these techniques with those obtained by the rapid solidification of melts.

43546 **(LBL—22837) Fatigue and thermal fatigue of Pb-Sn solder joints.** Frear, D.; Grivas, D.; McCormack, M.; Tribula, D.; Morris, J.W. Jr. (Lawrence Berkeley Lab., CA (USA)). Jan 1987. Contract AC03-76SF00098. 12p. (CONF-870272—6). NTIS, PC A02/MF A01; GPO Dep. File Number DE87012881.

From American Institute of Metallurgical Engineers annual meeting: light metals session; Denver, CO, USA (22 Feb 1987).

This paper presents a fundamental investigation of the fatigue and thermal fatigue characteristics, with an emphasis on the microstructural development during fatigue, of Sn-Pb solder joints. Fatigue tests were performed in simple shear on both 60Sn-40Pb and 5Sn-95Pb solder joints. Isothermal fatigue tests show increasing fatigue life of 60Sn-40Pb solder joints with decreasing strain and temperature. In contrast, such behavior was not observed in the isothermal fatigue of 5Sn-95Pb solder joints. Thermal fatigue results on 60Sn-40Pb solder cycled between -55°C and 125°C show that a coarsened region develops in the center of the joint. Both Pb-rich and Sn-rich phases coarsen, and cracks form within these coarsened regions. The failure mode 60Sn-40Pb solder joints in thermal and isothermal fatigue is similar: cracks form intergranularly through the Sn-rich phase or along Sn/Pb interphase boundaries. Extensive cracking is found throughout the 5Sn-95Pb joint for both thermal and isothermal fatigue. In thermal fatigue the 5Sn-95Pb solder joints failed after fewer cycles than 60Sn-40Pb.

43547 **(LBL—23531) Magnetic field dependence of the specific heat of some high-T/sub c/.** Phillips, N.E.; Fisher, R.A.; Lacy, S.E.; Marcenat, C.; Olsen, J.A.; Ham, W.K.; Stacy, A.M. (Lawrence Berkeley Lab., CA (USA)). Apr 1987. Contract AC03-76SF00098. 10p. (CONF-870873—8). NTIS, PC A02/MF A01; GPO Dep. File Number DE87011101.

From 18. conference on low temperature physics; Kyoto, Japan (20 Aug 1987).

The specific heats, C, of 5 samples of La/sub 1.85/M/sub 0.15/CuO/sub 4-y/ (M = Ca, Sr, Ba), one sample of La_2CuO/sub 4-y/, and one sample of YBa_2Cu_3O/sub 9-y/ have been measured between 0.4 and 40K, in magnetic fields, H, to 7T. For the La/sub 1.85/M/sub 0.15/CuO/sub 4-y/ samples the H dependence of C near T/sub c/ and near 1K, where C is dominated by the electronic contribution, gives information about the fraction of the sample that is a bulk superconductor and the density of electronic states. The fraction of bulk superconductivity indicated by the Meissner effect does not correlate well with that indicated by C. La_2CuO/sub 4-y/ has a linear term in C, in qualitative agreement with a theoretical prediction.

43548 **(N—87-22033) Study of microstructural characteristics of Ni-based superalloys at high temperatures. Semiannual technical report.** Lal, R.B.; Aggarwal, M.D. (Alabama A and M Univ., Normal (USA)). May 1987. 66p. (NASA-CR—180594; NAS—1.26:180594; AAMU-NAG—001). NTIS, PC A04/MF A01.

The microstructure of the Ni-based superalloy MAR-M246 (Hf), which is used in manufacturing the components of the Space Shuttle Main Engine, was investigated. In the first year, the superalloy will be studied using optical photomicrographs and the differential thermal analysis. During this period, the existing experimental equipment like cutting, grinding/polishing machines, metallurgical microscope will be used to but/polish and take the photomicrographs. At present, only a 35 mm camera attachment with the olympus inverted metallurgical microscope is being used. Due to this, there was considerable delay in processing photographs. A Perkin-Elmer Differential Thermal Analyzer (DTA-1700) was ordered and finally installed on April 28, 1987. Preliminary test runs were made on silver as well as MAR-M246 (Hf).

43549 (N—87-22034) **Application of single crystal superalloys for Earth-to-orbit propulsion systems.** Dreshfield, R.L.; Parr, R.A. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1987. 15p. (CONF-8706157—3; NASA-TM—89877; E—3556; NAS—1.15:89877; AIAA—87-1976). NTIS, PC A02/MF A01.

From 23. AIAA/SAE/ASME/ASEE joint propulsion conference; San Diego, CA, USA (29 Jun 1987).

The space shuttle main engine (SSME) and potential advanced earth-to-orbit propulsion systems impose severe conditions on turbopump turbine blades which for some potential failure modes are more severe than in aircraft gas turbines. Research activities which are directed at evaluating the potential for single crystal superalloys for application as turbopump turbine blades in the SSME and advanced rocket engines are discussed. The mechanical properties of these alloys are summarized and the effects of hydrogen are noted. The use of high gradient directional solidification and hot isostatic pressing to improve fatigue properties is also addressed.

43550 (N—87-22179) **High temperature static strain gage alloy development program. Final report.** Hulse, C.O.; Bailey, R.S.; Lemkey, F.D. (United Technologies Research Center, East Hartford, CT (USA)). Mar 1985. 90p. (NASA-CR—174833; NAS—1.26:174833; R—85-915952-13). NTIS, PC A05/MF A01.

The literature, applicable theory and finally an experimental program were used to identify new candidate alloy systems for use as the electrical resistance elements in static strain gages up to 1250K. The program goals were 50 hours of use in the environment of a test stand gas turbine engine with measurement accuracies equal to or better than 10 percent of full scale for strains up to + or - 2000 microstrain. As part of this effort, a computerized electrical resistance measurement system was constructed for use at temperatures between 300K and 1250K and heating and cooling rates of 250K/min and 10K/min. The two best alloys were an iron-chromium-aluminum alloy and a palladium base alloy. Although significant progress was made, it was concluded that a considerable additional effort would be needed to fully optimize and evaluate these candidate systems.

43551 (N—87-22267) **Elevated temperature crack growth. Annual report.** Malik, S.N.; Vanstone, R.H.; Kim, K.S.; Laflen, J.H. (General Electric Co., Cincinnati, OH (USA)). Jan 1987. 43p. (NASA-CR—179601; NAS—1.26:179601). NTIS, PC A03/MF A01.

The objective of the Elevated Temperature Crack Growth Program is to evaluate proposed nonlinear fracture mechanics methods for application to hot section components of aircraft gas turbine engines. Progress during the past year included linear-elastic fracture mechanics data reduction on nonlinear crack growth rate data on Alloy 718. The bulk of the analytical work centered on thermal gradient problems and proposed fracture mechanics parameters. Good correlation of thermal gradient experimental displacement data and finite element prediction was obtained.

43552 (N—87-22766, pp vp) **Deformation and fatigue behavior of SSME turbopump blade materials.** Milligan, W.W.; Antolovich, S.D. 1987. NTIS, PC A10/MF A01. (CONF-8705148—; NASA-CP—2471; E—3512; NAS—1.55:2471).

From NASA conference on structural integrity and durability of reusable space propulsion systems; Cleveland, OH, USA (11 May 1987).

Directionally solidified and single crystal superalloys which are intended for use as turbopump blade materials are anisotropic both elastically and plastically. Therefore, isotropic constitutive models must be modified. Several models which are now being developed are based on metallurgical theories of deformation in these types of alloys. However, these theories have not been fully justified, and the temperature and strain regimes over which they may be valid are poorly defined. The objective of this work is to study the deformation behavior of the alloys, in order to determine the validity of these models and to thereby support the ongoing research efforts in solid mechanics.

43553 (N—87-22766, pp vp) **Effect of hydrogen on deformation structure and properties of CMSX-2 nickel-base single-crystal superalloy.** Dollar, M.; Bernstein, I.M.; Walston, S.; Prinz, F.; Domnanovich, A. 1987. NTIS, PC A10/MF A01. (CONF-8705148—; NASA-CP—2471; E—3512; NAS—1.55:2471).

From NASA conference on structural integrity and durability of reusable space propulsion systems; Cleveland, OH, USA (11 May 1987).

Material used in this study was a heat of the alloy CMSX-2. This nickel-based superalloy was provided in the form of oriented single crystals, solutionized for 3 hrs at 1315 C. It was then usually heat treated as follows: 1050 C/16h/air cool + 850 C/48h/air cool. The resulting microstructure is dominated by cuboidal, ordered gamma precipitates with a volume fraction of about 75% and an average size of 0.5 microns. In brief, the most compelling hydrogen induced-changes in deformation structure are: (1) enhanced dislocation accumulation in the gamma matrix; and (2) more extensive cross-slip of superdislocations in the gamma precipitates. The enhanced dislocation density in gamma acts to decrease the mean free path of a superdislocation, while easier cross slip hinders superdislocation movement by providing pinning points in the form of sessile jobs. Both processes contribute to the increase of flow stress and the notable work hardening that occurs prior to fracture.

43554 (N—87-22811) **Fiber reinforced superalloys.** Petrasek, D.W.; Signorelli, R.A.; Caulfield, T.; Tien, J.K. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Apr 1987. 62p. (NASA-TM—89865; E—3533; NAS—1.15:89865). NTIS, PC A04/MF A01.

Improved performance of heat engines is largely dependent upon maximum cycle temperatures. Tungsten fiber reinforced superalloys (TFRS) are the first of a family of high temperature composites that offer the potential for significantly raising hot component operating temperatures and thus leading to improved heat engine performance. This status review of TFRS research emphasizes the promising property data developed to date, the status of TFRS composite airfoil fabrication technology, and the areas requiring more attention to assure their applicability to hot section components of aircraft gas turbine engines.

43555 (N—87-22860) **Friction and wear of sintered alpha SiC sliding against IN-718 alloy at 25 to 800 C in atmospheric air at ambient pressure.** Deadmore, D.L.; Sliney, H.E. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Jul 1986. 30p. (NASA-TM—87353; E—3107; NAS—1.15:87353). NTIS, PC A03/MF A01.

The sliding friction and wear of the SiC-nickel based alloy IN-718 couple under line contact test conditions in atmospheric air at a linear velocity of 0.18 m/sec and a load of 6.8 kg (67N) was investigated at temperatures of 25 to 800 C. It was found that the coefficient of friction was 0.6 up to 350 C then decreased to 0.3 at 500 and 800 C. It is suggested that the sharp decrease in the friction in the range of 350 to 550 C is due to the lubrication value of oxidation products. The wear rate reaches a minimum of 1 x 10 to the -10 to 2 x 10 to the -10 cu cm/cm/kg at 400 to 600 C.

43556 (ORNL/M—396) **Bibliography of the technical literature of the Materials Joining Group, Metals and Ceramics Division, 1951 through June 1987.** David, S.A.; Goodwin, G.M.; Gardner, K. (comps.). (Oak Ridge National Lab., TN (USA)). Aug 1987. Contract AC05-84OR21400. 50p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013869.

This document contains a listing of the written scientific information originating in the Materials Joining Group (formerly the Welding and Brazing Group), Metals and Ceramics Division, Oak Ridge National Laboratory during 1951 through June 1987. It is a registry of about 400 documents as nearly as possible in the order in which they were issued.

43557 **(ORNL/Sub—84-89628/01) Study of particle rebound characteristics and material erosion at high temperature: Final technical report for period April 1984 to December 1986.** Tabakoff, W.; Hamed, A.; Eroglu, H. (Cincinnati Univ., OH (USA). Dept. of Aerospace Engineering and Engineering Mechanics). 1987. Contract AC05-84OR21400. 126p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87013401.

The Laser Doppler Velocimeter (LDV) system was used to measure the rebounding characteristics of 15 micron mean diameter fly ash particles impacting several target materials. The rebounding velocities and angles were determined for 410 stainless steel, 2024 aluminum, 6A1-4V titanium, INCO 718, RENE 41, AM355, L605 cobalt, and alumina (Al_2O_3) target materials at different impact angles. In addition, AM355 steel alloys were tested at five different impact velocities of 75, 150, 320, 450 and 650 ft/sec. Rebounding measurements were also taken for 2024 aluminum alloy, using 200 microns mean diameter sand particles. A comparison was made between the rebounding results using sand and ash particles. Tests were also conducted with two different L605 cobalt sample material thicknesses. An erosion study was conducted to measure the erosion rate for the 2024 aluminum, 6A1-4V titanium, 304 stainless steel, RENE 41, A286, AM355 and L605 cobalt target materials impacted by fly ash particles. The effect of the following parameters on erosion was investigated: particle sizes, composition, velocity, impingement angle and temperature. 14 refs., 122 figs., 16 tabs.

43558 **(RFP—4120) The right tool for machining beryllium.** Johns, W.L.; Jackson, M.H. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). [1987]. Contract AC04-76DP03533. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012220.

Machine tools from the C-2, C-4, and C-7 designation were examined in this study. Overall twelve different machine tools from these grades were evaluated. Each machine tool was used to machine beryllium and then examined to determine wear characteristics. They were then polished and etched to reveal microstructure. The microstructure was examined on a scanning electron microscope (SEM) equipped with an energy dispersive spectrometer (EDS).

43559 **(SAND—87-1156C) Grain boundary effects in processing high T/sub c/ superconductors.** Ginley, D.S.; Venturini, E.L.; Kwak, J.F.; Baughman, R.J.; Morosin, B. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 6p. (CONF-871027—12). NTIS, PC A02. File Number DE87009297.

From 172. meeting of the Electrochemical Society; Honolulu, HI, USA (18 Oct 1987).

The advent of superconductors with transitions above 77K has tremendous practical implications. We demonstrate that even in single phase $YBa_2Cu_3O_7$, intergrain effects at high temperature (700 to 1100°C) dominate the synthesis of the material. In fact, superconductivity occurs in thin shells (<0.4 microns) surrounding nonsuperconducting grains in all of the recent high T/sub c/ materials independent of stoichiometry and synthesis method. We believe the nature of the superconducting shells to be unique and present data demonstrating their existence and the mechanism of their formation.

43560 **(SAND—87-1296) The effect of high temperature braze thermal cycles on mechanical properties of a dispersion strengthened copper alloy.** Stephens, J.J.; Schmale, D.T. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1987. Contract AC04-76DP00789. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013976.

Room temperature (RT) and elevated temperature (200 to 400°C) mechanical properties were determined on thin tubes of low oxygen grade Glidcop Al-15 (CDA alloy 15715) (99.7% Cu) in both the as-cold worked condition and subsequent to high temperature braze thermal cycles. For the RT tests, three different braze thermal cycles were employed: (1) 5 min at 870°C cycle, (2) 30 min at 870°C cycle, (3) 5 min at 980°C cycle. Results of RT tests showed that ultimate tensile strength declined from 486 MPa to ~425 MPa in the thermally cycled condition. Typical tensile ductilities at RT increased from 8% to ~18%. The effect of the braze thermal cycle is to apparently induce a modest amount of recovery (without recrystallization) in the dispersion strengthened matrix. These results are consistent with long term annealing studies conducted on solid rectangular bar pieces of Glidcop Al-15. In the elevated temperature (200 to 400°C) tensile property tests, the effect of the braze cycle on ultimate tensile strength is most pronounced at 200°C, but becomes negligible by 400°C. The dependence of ultimate tensile strength on imposed strain rate and temperature can be adequately characterized by a phenomenological creep equation appropriate for the power-law breakdown regime. Analysis of the low temperature creep data for Thoria dispersed nickel of Wilcox and Clauer is included to demonstrate that the phenomenological equation used has general applicability for the case of oxide dispersion strengthened metals at homologous temperatures <0.5T/sub M/.

43561 **(UCRL—95832) Direct observation of the disorder-order transition in Ni-V alloys in the high-voltage electron microscope.** Mayer, J.; Tanner, L.E.; Urban, K. (Lawrence Livermore National Lab., CA (USA); Max-Planck-Institut fuer Metallforschung, Stuttgart (Germany, F.R.). Inst. fuer Physik; Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Festkoerperforschung). Jul 1987. Contract W-7405-ENG-48. 8p. (CONF-870719—3). NTIS, PC A02. File Number DE87013561.

From 2. international conference on phase transformations in solids; Cambridge, UK (6 Jul 1987).

The ordering transitions in Ni-rich Ni-V alloys have been studied in situ in a high-voltage electron microscope. The equilibrium ordered structures, Ni_3V and Ni_2V, evolve directly from the disordered state. No order-fluctuations above the critical temperatures could be observed. The predicted special-point ordering instability was not found. Results are discussed in items of the spinodal ordering theory.

43562 **(UCRL—95988) Development of ultrafine grains and related properties in Hadfield manganese steels.** Goldberg, A.; Sherby, O.D. (Lawrence Livermore National Lab., CA (USA); Stanford Univ., CA (USA)). 16 Jun 1987. Contract W-7405-ENG-48. 10p. (CONF-871099—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011884.

From International conference on materials technology; Santiago, Chile (4 Oct 1987).

Through appropriate thermomechanical processing ultrafine grains were developed in Hadfield manganese steels. The austenite grains, 2- to 8-μm size, were stabilized against grain growth by dispersions of fine carbides, typically less than 1 μm. The steels contained from 1.2 to 1.7 wt % carbon and 12.3 to 16.3 wt % manganese. The processed materials were evaluated for superplastic properties at elevated temperatures (750 to 900°C). Values for the strain-rate sensitivity exponent (m) in the expression $\sigma = k \epsilon$ dot/ sup m/ ranged from 0.37 to 0.65. The value of m was found to depend on composition, grain size, temperature, and strain rate. At 23°C the fine-grain steels showed higher yield strengths and hardness values, but lower ductility, relative to values reported for commercially processed materials.

43563 **(UCRL—96344) Large-strain softening of aluminum at elevated temperature.** Kassner, M.E.; Oldani, J.J. (Lawrence Livermore National Lab., CA (USA)). 11 Jun 1987. Contract W-7405-ENG-48. 7p. (CONF-871099—2). NTIS, PC A02. File Number DE87011559.

From International conference on materials technology; Santiago, Chile (4 Oct 1987).

Recent work has shown that Al that is torsionally deformed to large strains at elevated temperature hardens to a peak stress beyond which a strain-softening is observed. This softening has been attributed to changes in the microstructure, a new operating deformation mechanism due to the dramatic increase in high-angle grain boundary area with increasing strain, or the evolution of a texture. New experiments and analysis are presented that support the conclusion that the large-strain softening is the result of a texture.

43564 **(UCRL—96361) Metallurgical effects on the constitutive and fragmentation behavior of OFHC copper rings.** Gourdin, W.H. (Lawrence Livermore National Lab., CA (USA)). 7 Jul 1987. Contract W-7405-ENG-48. 6p. (CONF-870753—51). NTIS, PC A02. File Number DE87013484.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

Preliminary results of recent constitutive and fragmentation studies on electromagnetically launched expanding ring specimens of fully annealed OFHC copper with grain sizes of 10, 30-50, 90-120, and 150-200 μm are reported. Grain size correlations with material behavior are developed and briefly discussed in reference to previous data, with particular attention to thermodynamic models of fragmentation.

43565 **(UCRL—96496) Experimental measurements and numerical simulations of metal spallation by detonating solid explosives.** Tarver, C.M.; Maiden, D.E. (Lawrence Livermore National Lab., CA (USA)). 14 Jul 1987. Contract W-7405-ENG-48. 5p. (CONF-870753—58). NTIS, PC A02. File Number DE87013227.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

Fabry-Perot laser interferometric measurements of the free surface velocities of tantalum and copper plates spalled by the detonating solid explosives LX-14, LX-17 and RX-26-AF are reported. Numerical calculations using the ignition and growth reactive flow model for the detonating explosive, the Steinberg-Guinan high strain rate constitutive model for the metal, and two different spall models are shown to accurately simulate the experimental records.

43566 **(UCRL—96696) An AEM study of the solid-state nucleation of metallic glass at grain boundaries.** Kamenetzky, E.A.; Meng, W.J.; Tanner, L.E.; Johnson, W.L. (Lawrence Berkeley Lab., CA (USA); Lawrence Livermore National Lab., CA (USA); California Inst. of Tech., Pasadena (USA). W.M. Keck Lab. of Engineering Materials). Jul 1987. Contract W-7405-ENG-48. 14p. (CONF-870733—11). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013801.

From Pacific workshop and meeting on analytical electron microscopy; Kona, HI, USA (12 Jul 1987).

As the solid-state amorphization reaction of Ni and Zr has already been studied in detail, purpose of this investigation is to study the role of grain boundaries in the nucleation of glass in this system. Zr foils were recrystallized and Ni layers sputter deposited. Annealing was carried out at 275 to 350°C. At 275°C, all glassy regions occur at grain boudaries. Small-and large-angle grain boundaries were studied. Nucleation is heterogeneous. Grain boundary impurities play a significant role. (DLC)

43567 **Are TiH_2 aggregates fractal?.** Schaefer, D.W.; Hurd, A.J.; Martin, J.E. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Physical Review Letters;* **59**: No. 4, 515-515(27 Jul 1987). Contract AC04-76DP00789.

A Comment on the Letter by Ph. Mangin, B. Rodmacq, and A. Chamberod, Phys. Rev. Lett. 55, 2899 (1985).

43568 **Fracture toughness behaviour of ferritic ductile cast iron.** Salzbrenner, R. (Sandia National Labs., Albuquerque, NM, USA). *Journal of Materials Science;* **22**: No. 6, 2135-2147(Jun 1987).

The static rate fracture toughness of a series of eight heats of ductile cast iron has been measured. Samples from each heat were tested in a heat treated condition which produced a fully ferritic matrix. The chemical composition and the microstructural feature size has also been measured directly from each specimen tested. A multiple linear regression method was used to establish a simple mathematical relationship between fracture toughness and the composition and microstructure. Fracture toughness was found to be strongly associated with the spacing (or size) of the graphite nodules in these fully ferritic ductile cast irons. Other features, including the composition, the ferrite grain size, or the amount of graphite (over the ranges examined), did not strongly influence the fracture toughness. Fracture toughness also did not correlate with tensile properties (i.e. strength or ductility) in these alloys.

43569 **Formation of perovskite surface layers by oxidation of Cu-La-Sr alloys.** Gruen, D.M.; Calaway, W.F.; Maroni, V.A.; Tani, B.S.; Krauss, A.R. (Materials Science, Chemistry, and Chemical Technology Divisions, Argonne National Lab., Argonne, IL 60439). *Journal of the Electrochemical Society;* **134**: No. 6, 1588-1589(Jun 1987). Contract W-31-109-ENG-38.

The recent discovery that perovskite-type crystal structures composed of La-Cu oxides substituted with small amounts of alkaline earth cations have exceptionally high superconducting critical temperatures has stimulated much interest in these potentially important materials. The most promising material reported thus far in the literature is La/sub 2-x/Sr/sub x/CuO/sub 4/. The substitution of an alkaline earth for La appears to stabilize a tetragonal structure as apposed to the orthorhombic structure of the parent compound, La/sub 2/CuO/sub 4/. In the work reported to date, the materials were prepared either by sintering mechanical mixtures of the oxides or carbonates or by co-precipitating the oxalates or carbonates with subsequent calcining and sintering steps.

43570 **'Sub-threshold' electron irradiation damage in hydrogen-charged aluminium.** Bond, G.M.; Robertson, I.M.; Zeides, F.M.; Birnbaum, H.K. (Illinois Univ., Urbana, USA. Dept. of Metallurgy and Mining Engineering; Illinois Univ., Urbana, USA. Materials Research Lab.). *Philosophical Magazine, A: Defects and Mechanical Properties;* **55**: No. 5, 669-681(May 1987). Contract AC02-76ER01198.

The effects of solute hydrogen on the electron irradiation damage of high-purity aluminium have been studied by means of a transmission electron microscope. Al-H alloys exhibited sub-threshold radiation damage in the form of interstitial loops and voids, while pure Al did not exhibit any evidence of sub-threshold damage. In the Al-H alloys, damage was observed with electron energies as low as 80 keV. The damage rates were qualitatively studied as a function of beam direction, H concentration and temperature. The results are consistent with an indirect energy transfer mechanism via the H interstitial intermediary.

43571 **Internal friction studies of the effect of hydrogen on the oxygen Snoek peaks in V and Nb.** Indrawirawan, H.; Brasche, L.J.H.; Owen, C.V.; Rehbein, D.K.; Carlson, O.N.; Peterson, D.T.; Buck, O. (Ames Lab., IA, USA). *Journal of Physics and Chemistry of Solids;* **48**: No. 6, 535-539(1987).

The effect of hydrogen in solid solution on the oxygen Snoek peak activation parameters in V and Nb have been investigated. Using an analysis, proposed by Weller and coworkers, the following activation parameters were obtained. For V: $\Delta H = 1.16 +- 0.03$ eV and τ_0 approx. $= 27 \times 10^{-15}$ s; for Nb: $\Delta H = 1.12 +- 0.03$ eV and τ_0 approx. $= 7 \times 10^{-15}$ s. The values of these parameters are independent of the hydrogen concentration in the alloys, indicating that there is no interaction of hydrogen and oxygen at the temperatures where the oxygen Snoek peaks occur.

43572 **On the growth of small fatigue cracks in aluminum-lithium alloy 2090.** Venkatesward-Rao, K.T.; Yu, W.; Ritchie, R.O. (Center for Advanced Materials, Lawrence Berkeley Lab., and Dept. of Materials Science and Mineral Engineering, Univ. of California, Berkeley, CA 94720). *Scripta Metallurgica;* **20**: No. 10, 1459-1462(1986). Contract AC03-76SF00098.

It is the objective of this article to examine the behavior of small (2 to 1000 μm) fatigue cracks in a commercial Al-Li-Cu-Zr alloy, and to compare results with those determined on conventional long (≧ 20 mm) crack samples. The development of ultra-lightweight aluminum-lithium alloys has aroused much interest in the aerospace industry with the prospect of the design of aircraft with alloys of lower density and increased modulus. Moreover, although Li additions can cause low ductility and toughness properties, Al-Li-X alloys generally show far superior fatigue crack growth resistance to traditional aluminum alloys, such as 2124 and 7050. However, the latter observations are based exclusively on long (≧ 10 mm) crack studies; to date little information is available on the behavior of small fatigue cracks in these alloys.

43573 **Local structural and magnetic environments of iron in dilute alloys.** Budnick, J.I.; Choi, M.; Pease, D.M.; Tan, Z.; Hayes, G.H.; Klein, E.; Illerhaus, B. (Dept. of Physics and Institute of Materials Science, The Univ. of Connecticut, Box U-46, Room 107, 2152 Hillside Road, Storrs, CT 06268). pp 58-64 of X-rays in materials analysis: Novel applications and recent developments. Rusch, T.W. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860880—).

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

Extended X-ray absorption fine-structure (EXAFS) of the iron atoms in Cu/sub 98/Fe/sub 2/, Cu/sub 67/Au/sub 30/Fe/sub 3/, and Cu/sub 69/Au/sub 30/Fe/sub 1/ are used to provide direct structural information about the Fe environments in these alloys. Fe in Cu/sub 98/Fe/sub 2/ is face-centered cubic γ-Fe, whereas Fe in the Cu-Au-Fe alloys is body centered cubic α-Fe. These results are in excellent agreement with the results deduced from the Mossbauer studies of the hyperfine field distributions in these systems.

43574 **Structure of icosahedral AlMnSi and AlMn as determined by extended x-ray absorption fine structure.** Ma, Y.; Stern, E.A. (Dept. of Physics, Univ. of Washington, Mail Stop FM-15, Seattle, WA 98195). pp 52-57 of X-rays in materials analysis: Novel applications and recent developments. Rusch, T.W. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860880—).

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

Results of Extended X-Ray Absorption Fine Structure (EXAFS) studies of aperiodic alloys of AlMn and related alloys are summarized. By comparing the EXAFS of icosahedra AlMnSi and AlMn with that of α (AlMnSi), it was found that Mn icosahedral of edge length $\approx$ 5 A are the structure units in the icosahedral phase. The connection among these icoshedral units is different from the connection in the α phase. Comparing the Fe and Mn sites in icosahedral AlMnFeSi and decagonal AlMnFe, indicates that Fe and Mn occupy the same sites in the icosahedral phase but different sites in the decagonal phase. The authors discuss these results in terms of the randomly connected icosahedra model (RCI) proposed for the icosahedral phase.

43575 **EXAFS and reflectivity studies of surfaces and interfaces using glancing angle x-rays.** Heald, S.M.; Chen, H.; Tranquada, J.M. (Dept. of Applied Science, Brookhaven National Lab., Upton, NY 11973). pp 32-37 of X-rays in materials analysis: Novel applications and recent developments. Rusch, T.W. Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860880—). Contract AS05-80ER10742.

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

X-rays at glancing angles have a short controllable penetration depth which can be used to advantage in studying surfaces and interfaces. Data are presented for Cu-Al and Ag-Au bilayers which demonstrate the utility of x-ray reflectivity and extended x-ray absorption fine structure (EXAFS) measurements. X-ray reflectivity measurements are sensitive to layer thickness and interface roughness, while the EXAFS probes the atomic scale environment of the interface atoms. As the samples are annealed clear changes are observed in both techniques indicative of the growth of interfacial CuAl/sub 2/ for the Cu-Al samples and interdiffusion for Ag-Au. Interface sensitivity is verified for the Cu-Al samples.

43576 **Time-dependent x-ray reflectivity of a germanium crystal heated with 25 ps 1.06 μm laser light.** Hailey, C.J.; Busch, G.; Johnson, R.; Koenig, Z.; Lupton, J.; Schroeder, R.; Sullivan, D.; Goldstein, W. (KMS Fusion, Inc., Ann Arbor, MI 48106). pp 19-22 of X-rays in materials analysis: Novel applications and recent developments. Rusch, T.W. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860880—).

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

Preliminary experimental and theoretical studies have been undertaken of the time dependent x-ray reflectivity of a germanium crystal under pulsed laser illumination. The integrated x-ray reflectivity is used as a temperature probe of the crystal. The Chroma laser system at KMS Fusion provided a 1.054 μm (IR) heating pulse with a 25 ps (FWHM) width. Fluences on the germanium (333) crystal varied from 0 to 2 J/cm/sup 2/. The germanium crystal was simultaneously irradiated with high intensity x-rays from a laser plasma. The emitting plasma was formed by directing a high energy, 0.527 μm laser at a manganese target. The time history of the x-rays reflected from the crystal was detected by an x-ray streak camera. A computer code was written which models temperature dependent dynamical x-ray diffraction. The code takes into account the heating beam absorption profile, depth-dependent Debye-Waller effect and thermal strain profile. The present setup is sensitive to reflectivity changes of 20%. With some improvements, the technique appears to have some promise for real-time studies of crystal behavior.

43577 **Comparison of experimental and theoretical calculations of backscattering amplitude and phase shift functions for a number of fcc metals.** Knapp, G.S.; Mc Kale, A.G.; Chan, S.K.; Veal, B.W. (Surface Science Labs., 465 National Avenue, Mountain View, CA 94043). pp 3-8 of X-rays in materials analysis: Novel applications and recent developments. Rusch, T.W. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860880—).

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

Extended x-ray absorption fine structure (EXAFS) spectra have been acquired experimentally for a number of fcc metals with atomic number Z between 28 (Ni) and 90 (Th). The backscattering amplitude and phase shift functions have been extracted from the data and compared with calculations based on a single scattering theory, using for the ejected electron, the exact curved wave function. The calculated functions obtained with the curved wave formalism provide increased accuracy, particularly at low k, i.e. $k < 4$ A/sup -1/, compared to those obtained with the plane wave approximation.

43578 **Weak superconductivity in metallic superlattices.** Schuller, I.K. (Materials Science and Technology Div., Argonne National Lab., Argonne, IL 60439). pp 359-373 of Josephson effect: Achievements and trends. Barone, A. Teaneck, NJ; World Scientific Pub. Co. (1986). Contract W-31-109-ENG-38.

Presented here are results on weak superconductivity effects in metallic superlattices. Experimental data on superconductivity transition temperatures, energy gaps and phonon spectrum are presented. Dimensional behavior and interaction of superconductivity and magnetism is observed in the upper critical field as a function of temperature, angle and layer thickness.

3602 Ceramics, Cermets, And Refractories

REFER ALSO TO CITATION(S) 43536, 43555, 43790, 44629

43579 **(AD-A—181173/6/XAB) Effect of oxygen pressure on volatility and morphology of LaB_6 single-crystal cathodes.** Davis, P.R.; Schwind, G.A.; Swanson, L.W. (Oregon Graduate Center, Beaverton (USA)). Feb 1986. 6p. NTIS, PC A02/MF A01.

Pub. in Jnl. of Vacuum Science and Technology B, Vol. 4, No. 1, 112-115(Jan/Feb 1986).

Single crystal LaB_6 has become an important cathode material for a variety of electron-beam systems. At the typical operating pressures of many such systems interaction of the cathode with the residual gases present can cause radical enhancement of the cathode volatility with concomitant change in the usual conical shape, oxygen-bearing gases being the most active in promoting such effects. This paper discusses a systematic investigation of the variation of volatility and morphology of heated LaB_6 cathodes with oxygen pressure.

43580 **(BNL—40064) Magnetization studies of high T/ sub c/ $YBa_2Cu_3O_7$.** Ghosh, A.K.; Suenaga, M.; Asano, T.; Moodenbaugh, A.R.; Sabatini, R.L. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 7p. (CONF-8706125—10). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013307.

From Conference on advances in cryogenic engineering; St. Charles, IL, USA (14 Jun 1987).

A number of superconducting $YBa_2Cu_3O_7$ specimens were made by sintering appropriate amounts of $BaCO_3$, Y_2O_3 and CuO powders. The superconducting properties of these samples were characterized by measuring resistive and inductive critical temperatures T/sub c/ and magnetization at 4.3K. Measurements indicate that the specimens behave as granular superconductors. Critical current densities estimated from magnetization data indicate that the J/sub c/ in these materials exceed 10^5 A/cm^2 at 1 Tesla.

43581 **(CONF-870422—8) X-ray tomography and nuclear magnetic resonance imaging applications for advanced ceramic materials.** Ellingson, W.A.; Sawicka, B.D.; Kritz, R.J.; Gronemeyer, S.; Ackerman, J.L. (Argonne National Lab., IL (USA); Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.; Illinois Univ., Chicago (USA). Medical Center; Massachusetts General Hospital, Boston (USA); Siemens Medical Systems, St. Louis, MO (USA); Harvard Medical School, Boston, MA (USA)). Feb 1987. Contract W-31109-ENG-38. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011534.

From 89. annual meeting of the American Ceramic Society; Pittsburgh, PA, USA (26 Apr 1987).

Advanced nondestructive evaluation methods are being developed to characterize ceramic materials and allow improvement of process technology. If one can determine porosity, map organic binder/plasticizer distributions, through-volume density, and detect inclusions, machine operations can then be modified to enhance the reliability of ceramics. Two modes of X-ray tomographic imaging - advanced film tomography and computed tomography - are being developed to provide flaw detection and density profile mapping capability. Nuclear magnetic resonance imaging is being developed to determine porosity and map organic binder/plasticizer distribution. Results obtained with these methods are presented.

43582 **(CONF-870733—9) EXELFS [Extended Electron Energy Loss Fine Structure] analyses at 300 kV and 1 MV.** Sevely, J.C.; Angelini, P.; Hssein, Khalid; Zanchi, G. (Oak Ridge National Lab., TN (USA); Centre National de la Recherche Scientifique, 31 - Toulouse (France). Lab. d'Optique Electronique). 1987. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013679.

From Pacific workshop and meeting on analytical electron microscopy; Kona, HI, USA (12 Jul 1987).

Measurements of EXELFS (Extended Electron Energy Loss Fine Structure), from various materials, were made with the use of an intermediate voltage microscope operated at 300 kV and an HVEM operated at 1 MV. Analysis of data taken from relatively thin regions, $t/\lambda < .4$, were found to agree. In addition, for thicker regions of SiC ($t/\lambda = 0.9$), when the low loss contribution to the Si K edge was removed, the results for the interatomic spacings as well as their relative intensities were found to agree with the results from thinner regions. Results show that intermediate voltage microscopes are well suited for performing EXELFS measurements.

43583 **(CONF-870981—1) A review of oxide, silicon nitride, and silicon carbide brazing.** Santella, M.L.; Moorhead, A.J. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 12p. NTIS, PC A02. File Number DE87014055.

From Influence of new materials development on weldability; Columbus, OH, USA (29 Sep 1987).

There is growing interest in using ceramics for structural applications, many of which require the fabrication of components with complicated shapes. Normal ceramic processing methods restrict the shapes into which these materials can be produced, but ceramic joining technology can be used to overcome many of these limitations, and also offers the possibility for improving the reliability of ceramic components. One method of joining ceramics is by brazing. The metallic alloys used for bonding must wet and adhere to the ceramic surfaces without excessive reaction. Alumina, partially stabilized zirconia, and silicon nitride have high ionic character to their chemical bonds and are difficult to wet. Alloys for brazing these materials must be formulated to overcome this problem. Silicon carbide, which has some metallic characteristics, reacts excessively with many alloys, and forms joints of low mechanical strength. The brazing characteristics of these three types of ceramics, and residual stresses in ceramic-to-metal joints are briefly discussed.

43584 **(DOE/ER/10588—T1) Ceramics Processing Research Laboratory: Physics and chemistry of packing fine ceramic powders: Final report for the period January 1, 1981-June 30, 1986.** Bowen, H.K. (Massachusetts Inst. of Tech., Cambridge (USA). Ceramics Processing Research Lab.). 1986. Contract AC02-80ER10588. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013709.

The following were studied: formation and compaction of monosized silica; synthesis, characterization, and sintering of TiO_2 powders; ordered packing and osmotic pressure of SiO_2; synthesis and surface chemistry of Si and SiC powders; particle interactions; and polydispersity in ceramic suspensions. (DLC)

43585 **(DOE/ER/45049—1) Fabrication, phase transformation studies and characterization of SiC-AlN-Al_2OC ceramics.** Virkar, A.V. (Utah Univ., Salt Lake City (USA). Dept. of Materials Science and Engineering). Apr 1986. Contract AC02-84ER45049. 49p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013687.

During the current contract period, after the initial background work on equipment acquisition and apparatus fabrication, work has progressed in three areas: (1) Phase relations in the SiC-AlN-Al_2OC system and phase transformations, (2) high temperature creep deformation, (3) analysis of phase transformation kinetics. The major highlights of the work to date are as follows: Demonstration of phase transformations in the SiC-AlN, AlN-Al_2OC and SiC-AlN-Al_2OC systems. Development of an analysis of phase transformation kinetics with both diffusion and interface parameters comparable. Demonstration of the dependence of creep behavior on grain size and composition.

43586 **(DOE/ER/45093—T2) Laser chemically vapor deposited silicon-carbide: Growth features, topography, microstructure, and composition: Final report.** Shaapur, F. (University of Southern California, Los Angeles (USA)). May 1987. Contract FG03-84ER45093. 119p. NTIS, PC A06. File Number DE87013767.

Laser chemically vapor deposited SiC films were formed on SiO_2, Si, and SiC substrates from monomethyl dichlorosilane (CH_3SiHCl_2) or mixtures of SiH_4 and CH_4. The depositing laser wavelength was chosen such that the reactants were transparent and the substrates absorptive, including the 9.27 and 10.6 μm lines of the CO_2 laser and 514 nm line of the Ar^+ laser. Deposition rates as high as 2.25 mm/s measured for the $Si/Ar^+/CH_3SiHCl_2$ system were attributed to an enhanced growth phenomenon. In the case of deposition on SiC substrate, a linear behavior was observed. The reflectivity and absorptivity of hot pressed SiC material used as a substrate in these experiments was measured in support of heat flow analysis. A new experimental technique was devised by which the accuracy of the heat flow model predictions was verified. The films were characterized by scanning electron microscopy, electron diffraction analysis, and energy dispersive and wavelength dispersive analyses. Deposited material in general consisted of fine-grained polycrystalline phases of SiC, Si, and C with the grain size ranging from 200 to 3500 A for deposition on SiC and SiO_2 substrates, respectively. Spontaneous periodic surface structures observed on deposits from the $SiC/CO_2/SiH_4 + CH_4$ system were explained via a new theory.

43587 (DOE/ER/45168—3) Investigations of hard, carbon-based surface coatings: From "diamond-like" carbon to silicon carbide: Final report for period July 1, 1984-June 30, 1987. Smith, F.W. (City Coll., New York (USA). Dept. of Physics). Jul 1987. Contract FG02-84ER45168. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013858.

Results obtained during the duration of this grant, July 1984 to June 1987, from our experimental studies of hard, carbon-based surface coatings are presented. The optical constants ($\epsilon = \epsilon_1 + i\ \epsilon_2$) of a series of amorphous hydrogenated silicon-carbon alloy films (a-Si/sub 1-x/C/sub x/:H, $0 \leqq x \leqq$) have been measured. These results have been modeled via the effective medium approximation as arising from a microstructure consisting of three amorphous components: polymeric, graphitic, and tetrahedral, along with a void component. An Si- and C-centered tetrahedron model has been developed for predicting the optical response of the tetrahedral component. Our results indicate that the addition of Si to a-C:H films does enhance the tetrahedral coordination, leading to an increase in the optical gap. We have evidence from our analysis that complete chemical ordering with homogeneous dispersion exists within the tetrahedral component. Using our Si-centered tetrahedron model, we have also investigated the effect of interface alloying on the optical response of a-Si:H/a-Si/sub x/N/sub 1-x/:H multilayers.

43588 (INIS-BR—672) Analysis of ZnO.CoO system through x-ray diffraction and mercury porosimetry. Freires, A.P.; Varela, J.A.; Longo, E. (Centro de Tecnologia Educacional para Engenharia, Sao Paulo (Brazil)). 1985. 1p. (In Portuguese). (CONF-8512129—1-Summ.). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702594.

From 4. congress of scientific and technological engineering; Sao Carlos, Brazil (1 Dec 1985).

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43589 (IS-T—1305) A low-temperature synthetic route to a novel molybdenum oxide "Mo_2O_3". Tyszkiewicz, M.T. (Ames Lab., IA (USA)). Aug 1987. Contract W-7405-ENG-82. 66p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87013604.

The use of "molecular precursors" in low temperature routes to high temperature materials has achieved great success in ceramic processing. The thermal and hydrolytic decomposition products of metal alkoxides has become a favored route to high purity ceramics. This procedure limits impurities in the system and it gives a high surface area precursor for lower temperature sintering. The synthesis of Mo_2O_3 has been attempted via similar routes, using the controlled hydrolysis of appropriate labile molybdenum compounds. Mo_2(OPr/sup i/)$_6$ and $Mo_2(NMe_2)_6$ were selected as starting materials.

43590 (IS-T—1325) Measurement of agglomerate strength distributions in agglomerated powders. Ciftcioglu, M. (Ames Lab., IA (USA)). Aug 1987. Contract W-7405-ENG-82. 166p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87013605.

A new technique for measuring the strength distributions of powder agglomerates involves the use of a calibrated ultrasonic sound field. Agglomerate strength distributions were measured for a variety of yttria and yttria-stabilized zirconia powders. Different preparation methods were used in order to obtain powders containing agglomerates with different characteristics. Special yttria powders containing agglomerates of 0.1 μm, spherical, monosize spheres were also prepared. BET surface area, tap density, pressed density, compaction curves, and mercury intrusion curves were also obtained. The powders were pressed and sintered, and the sintered density measured for each pellet. Smooth curves could be drawn when agglomerate strength was plotted against sintered density; the sintered density of the powders also could be ranked directly according to the strength of the agglomerates in each powder. Except for the model yttria powders containing monosize spherical particles, there was no correlation between sintered density and any other measured powder parameter. For this model powder, most of measured powder parameters correlated directly with sintered density, in almost textbook fashion. It was also possible, using these model powders, to isolate the effect of agglomerate strength on sintered density by holding all other powder characteristics constant.

43591 (N—87-22052) Tensile strength of engineering ceramics. Fujisawa, Y.; Matusue, K.; Takahara, K. (National Aerospace Lab., Chofu, Tokyo (Japan)). 1986. 11p. (NAL-TR—900). NTIS, PC A02/MF A01.

Uniaxial tensile strength tests of engineering ceramics were carried out in air at temperatures ranging from room temperature up to 1600 C. The ceramic materials chosen for tensile tests were selected as representing existing and developing silicon nitride, silicon carbide and partially stabilized zirconia materials technology, suitable for gas turbine applications. The tensile strength of silicon nitride rapidly decreased at temperatures above 800 to approx. 1000 C. When the temperature increased to as high as 1300 C, the strength decreased to about 10 percent of room temperature strength. On the other hand, the strength of silicon carbide did not change appreciably with temperature. The strength of zirconia decreased with increasing temperatures. At 1000 C the strength was reduced to 8 percent of room temperature strength. Observations of the fracture origin and of the crack propagation on the fracture surfaces are discussed.

43592 Ceramics for fusion applications. Clinard, F.W. Jr. (Los Alamos National Lab., NM, USA). *Ceramics International;* **13**: No. 2, 69-75(1987).

Ceramics are required for a variety of uses in both near-term fusion devices and in commercial powerplants. These materials must retain adequate structural and electrical properties under conditions of neutron, particle and ionizing irradiation; thermal and applied stresses; and physical and chemical sputtering. Ceramics such as Al_2O_3, $MgAl_2O_4$, BeO, Si_3N_4 and SiC are currently under study for fusion applications, and results to date show widely-varying responses to the fusion environment. Materials can be identified today that will meet initial operating requirements, but improvements in physical properties are needed to achieve satisfactory lifetimes for critical applications.

43593 Preparation of YBa/sub 2/Cu/sub 3/O/sub 7/ and related compounds. Moodenbaugh, A.R.; Hurst, J.J. Jr.; Jones, R.H.; Suenaga, M. (Brookhaven National Lab., Upton, NY). pp 101-102 of Proceedings of symposium S at the 1987 Spring meeting of the MRS on high temperature superconductors (Extended Abstracts). Gubser, D.U.; Schluter, M. Pittsburgh, PA; Materials Research Society (1987). (CONF-870438—). Contract AC02-76CH00016.

From Spring meeting of the Materials Research Society; Anaheim, CA, USA (21 Apr 1987).

In regard to the preparation, by solid state sintering of powders, the authors prepare single phase samples and have successfully applied the method of solution of starting materials in nitric acid and oxalic acid to the preparation of YBa/sub 2/Cu/sub 3/O/sub 7/. Potential advantages of the solution method (compared to grinding powders) include reduced labor required for preparation of larger samples, more homogeneous samples, and possible preparation of novel compounds at lower temperatures.

43594 Grain boundary superconductivity in the YBaCuO system. Ginley, D.S.; Venturini, E.L.; Seager, C.H.; Schubert, W.K.; Baughman, R.J.; Kwak, J.F.; Schirber, J.E.; Morosin, B. (Sandia National Labs., Albuquerque, NM). pp 201-205 of Proceedings of symposium S at the 1987 Spring meeting of the MRS on high temperature superconductors (Extended Abstracts). Gubser, D.U.; Schluter, M. Pittsburgh, PA; Materials Research Society (1987). (CONF-870438—). Contract AC04-76DP00789.

From Spring meeting of the Materials Research Society; Anaheim, CA, USA (21 Apr 1987).

The authors demonstrate for a wide variety of compositions in the YBaCuO system that the efficient synthesis of the high temperature superconductor requires the formation of a liquid, barium-rich phase forming above 1000C. This superconducting phase coats the insulating grains resulting in complete magnetic flux exclusion in bulk materials.

43595 Phase diagram and superconductivity in the Y-Ba-Cu-O system. Capone, D.W. II; Hinks, D.G.; Soderholm, L.; Beno, B.; Jorgensen, J.D. (Argonne National Lab., Argonne, IL). pp 45-48 of Proceedings of symposium S at the 1987 Spring meeting of the MRS on high temperature superconductors (Extended Abstracts). Gubser, D.U.; Schluter, M. Pittsburgh, PA; Materials Research Society (1987). (CONF-870438—). Contract W-31-109-ENG-38.

From Spring meeting of the Materials Research Society; Anaheim, CA, USA (21 Apr 1987).

The discovery of high temperature superconductivity in perovskite-related oxides have generated an enormous amount of activity. Superconductivity above 30 K is initially reported in a multiphase system having a nominal stoichiometry of La/sub 5-x/Ba/sub x/Cu/sub 5/O/sub 5(3-y)/. Subsequent to this a previous study identifies the superconducting compound as (La/sub (1-x)/Ba/sub x/)/sub 2/CuO/sub 4/ with the K/sub 2/NiF/sub 4/ - type structure. Substitution of Ba by Sr is shown to produce relatively narrow super- conducting transitions with zero resistance near 40 K. Recently reported for the first time, superconductivity above 90 K in a multiphase sample has the nominal composition of Y/sub 1.2/Ba/sub 0.8/CuO/sub 4-∂/, and suggests that multiphase samples are necessary for the occurrence of such high critical temperatures. Contrary to this suggestion, the authors believe that the superconducting behavior exhibited by the material Y/sub 1.2/Ba/sub 0.8/CuO/sub 4-∂/ is in fact caused by a single minority phase in the multiphase sample. In this paper the authors report an extensive study of the part of the Y-Ba-Cu-O phase diagram in which superconductivity appears. From this diagram, determined using X-ray and neutron diffraction coupled with transport measurements, it is concluded that the superconducting material is a single phase.

43596 Mobile oxygen and isotope effect in the high temperature superconductor YBa/sub 2/Cu/sub 3/O/sub 7-δ/. Morris, D.E.; Scheven, U.M.; Bourne, L.C.; Cohen, M.L.; Crommie, M.F.; Zettl, A. (Univ. of California, Berkeley, CA). pp 209-214 of Proceedings of symposium S at the 1987 Spring meeting of the MRS on high temperature superconductors (Extended Abstracts). Gubser, D.U.; Schluter, M. Pittsburgh, PA; Materials Research Society (1987). (CONF-870438—).

From Spring meeting of the Materials Research Society; Anaheim, CA, USA (21 Apr 1987).

The authors present a study on the dependence of superconducting properties of YBa/sub 2/Cu/sub 3/O/sub 7-δ/ superconductors on the Oxygen content and thermal processing conditions. The Oxygen content of the material decreases progressively on heating in O/sub 2/ above —450°C, but this Oxygen loss is reversible upon slow cooling. Oxygen loss on heating in argon is larger, but still reversible upon annealing and slow cooling in O/sub 2/. The effect of thermal treatment in different atmospheres on the superconducting properties is described. The mobility of Oxygen is very high in this material, leading to a rapid approach to equilibrium Oxygen content after changes of temperature or Oxygen partial pressure in the space around the sample. Cooling rates are specified which optimize the final Oxygen content and are found to give good superconducting resistive transitions. The high Oxygen mobility permits replacement of the ordinary /sup 16/O isotope in a sintered sample by exchange with /sup 18/O/sub 2/ gas placed in the surrounding space, by simple counter-diffusion at an elevated temperature. An isotope effect experiment is carried out. The T/sub c/ of the /sup 18/O substitutes material the same as a similar sample heated in /sup 16/O, indicating the absence of an isotope effect in this material.

43597 Thin superconducting shells in single phase YBa/sub 2/Cu/sub 3/O/sub 7/. Venturini, E.L.; Ginley, D.S.; Schirber, J.E.; Kwak, J.F.; Baughman, R.J.; Morosin, B. (Sandia National Labs., Albuquerque, NM). pp 97-100 of Proceedings of symposium S at the 1987 Spring meeting of the MRS on high temperature superconductors (Extended Abstracts). Gubser, D.U.; Schluter, M. Pittsburgh, PA; Materials Research Society (1987). (CONF-870438—). Contract AC04-76DP00789.

From Spring meeting of the Materials Research Society; Anaheim, CA, USA (21 Apr 1987).

The magnetization in single phase YBa/sub 2/Cu/sub 3/O/sub 7/ shows a 5:1 ratio between flux exclusion (diamagnetic shielding) and flux expulsion (Meissner effect). These results plus other complementary data suggest that the superconductivity is confined to thin shells surrounding normal metallic grains.

43598 A status report on the Berkeley research on high T/sub c/ superconductors. Cohen, M.L.; Stacy, A.M.; Zettl, A. (Lawrence Berkeley Lab., Berkeley, CA). pp 93-96 of Proceedings of symposium S at the 1987 Spring meeting of the MRS on high temperature superconductors (Extended Abstracts). Gubser, D.U.; Schluter, M. Pittsburgh, PA; Materials Research Society (1987). (CONF-870438—). Contract AC03-76SF00098.

From Spring meeting of the Materials Research Society; Anaheim, CA, USA (21 Apr 1987).

The discovery of superconductivity above 30K in La-Ba-Cu-O stimulated considerable research on this system. The authors explore other materials simultaneously and discover superconductivity in the Y-Ba-Cu-O system independently of, but subsequent to, a previous discovery. This report also describes high temperature fluctuations in resistivity around 234K which were suggestive of superconducting filaments in this system. This study attempts to stabilize the high temperature effects with only partial success. The analysis reports on: search for isotope effect; resistivity and transport studies, infrared and tunneling measurements of the superconducting gap; measurements of elastic properties; some theoretical explorations; and some further studies of high temperature resistivity anomalies.

43599 Electron tunneling measurements in LaSrCuO and YBaCuO. Moreland, J.; Ekin, J.W.; Goodrich, L.F.; Capobianco, T.E.; Clark, A.F. (NBS, Boulder, CO). pp 73-76 of Proceedings of symposium S at the 1987 Spring meeting of the MRS on high temperature superconductors (Extended Abstracts). Gubser, D.U.; Schluter, M. Pittsburgh, PA; Materials Research Society (1987). (CONF-870438—).

From Spring meeting of the Materials Research Society; Anaheim, CA, USA (21 Apr 1987).

The break junction technique whereby vacuum tunneling occurs within the fracture of a bulk sample is used to study the LaSrCuO and YBaCuO perovskite superconductors. Structure in the current versus voltage characteristics is reminiscent of previous quasiparticle curves obtained for BCS superconducting materials. Some curves have anomalous qualities, including large dips in the junction conductance with increasing voltage just above a well defined tunneling gap edge linearly increasing junction conductance with an applied bias, along with features occurring near the voltage intervals with the 1, 3, 5 pattern.

43600 Pressure effects on high T/sub c/ superconducting oxides with the K/sub 2/NiF/sub 4/-type structure. Shelton, R.N.; Folkerts, T.J.; Klavins, P.; Ku, H.C. (Iowa State Univ., Ames, IA). pp 49-52 of Proceedings of symposium S at the 1987 Spring meeting of the MRS on high temperature superconductors (Extended Abstracts). Gubser, D.U.; Schluter, M. Pittsburgh, PA; Materials Research Society (1987). (CONF-870438—).

From Spring meeting of the Materials Research Society; Anaheim, CA, USA (21 Apr 1987).

In this study, the authors investigate the superconducting properties under hydrostatic pressure of three high T/sub c/ oxides with the composition (La/sub 1.85/M/sub 0.15/CuO/sub 4/, where M = Ca, Sr, Ba. These materials, which crystallize in the K/sub 2/NiF/sub 4/-type body-centered tetragonal structure (I4/mmm) or a related orthorhombic modification (Fmmm), have been the focus of intense experimental and theoretical research since the initial report of superconductivity above 30K in a multiphase sample of these ternary oxides. The effect of high pressure on T/sub c/ is an important factor in the investigation of the occurrence of superconductivity in ternary compounds. With few exceptions, pressure effects on the elements and binary compounds are nearly linear and small (usually vertical bar dT/sub c//dp vertical bar —10/sup -5/ K/bar). In contrast, there are numerous ternary superconductors that exhibit pronounced non-linearities in T/sub c/ versus pressure with values of dT/sub c//dp an order of magnitude higher than

normally observed. Reference is made to a large pressure sensitivity of T/sub c/ for some compounds with this structure.

43601 Transport critical-current characteristics of Y/sub 1/Ba/sub 2/Cu/sub 3/O/sub x/. Ekin, J.W.; Panson, A.J.; Braginski, A.I.; Janocko, M.A.; Hong, M.; Kwo, J.; Liou, S.H.; Capone, D.W. II; Flandermeyer, B. (NBS, Boulder, CO). pp 223-226 of Proceedings of symposium S at the 1987 Spring meeting of the MRS on high temperature superconductors (Extended Abstracts). Gubser, D.U.; Schluter, M. Pittsburgh, PA; Materials Research Society (1987). (CONF-870438—).

From Spring meeting of the Materials Research Society; Anaheim, CA, USA (21 Apr 1987).

The authors detail voltage vs. current (V-I) characteristics are measured at magnetic field up to 24 T at a temperature of 77 K in several Y/sub 1/Ba/sub 2/Cu/sub 3/O/sub x/ samples fabricated at different laboratories. Critical temperatures, T/sub c/, are measured by resistivity were about 93 K. All samples showed linear V-I characteristics at current levels much greater than the critical current, I/sub c/. However, the slope is significantly less than the normal resistance at T/sub c/. The slope increased with magnetic field and reached the normal resistance value only at fields greater than 24 T. Values of the transport critical-current density J/sub c/ near zero magnetic field are generally low and variable (about 1 to 200 A/cm/sup 2/. The transport J/sub c/ falls sharply when the magnetic field is applied, decreasing by about an order of magnitude between 10/sup -3/ T and 1 T. This leads to an effective upper critical field for transport critical currents in Y/sub 1/Ba/sub 2/Cu/sub 3/O/sub x/ that is significantly less than the upper critical field defined by the field at which the resistance increases to the normal-state value. The transport J/sub c/ appears significantly less than J/sub c/ calculates from magnetization data on similar samples. These results are consistent with the transport critical-current in the Y/sub 1/Ba/sub 2/Cu/sub 3/O/sub x/ system which is dominated by a "weak-link" region between high-J/sub c/ grains.

43602 Superconducting properties and microstructures of La/sub 1.85/Sr/sub 0.15/CuO/sub 4/ and YBa/sub 2/Cu/sub 3/O/sub x/. Suenga, M.; Ghosh, A.; Asano, T.; Sabatini, R.L.; Moodenbaugh, A.R. (Brookhaven National Lab., Upton, NY). pp 247-250 of Proceedings of symposium S at the 1987 Spring meeting of the MRS on high temperature superconductors (Extended Abstracts). Gubser, D.U.; Schluter, M. Pittsburgh, PA; Materials Research Society (1987). (CONF-870438—). Contract AC02-76CH00016.

From Spring meeting of the Materials Research Society; Anaheim, CA, USA (21 Apr 1987).

Drastic improvements in critical temperature T/sub c/ of superconductors recently made starting with the discovery of a La-Ba-Cu oxide by Bednorz and Muller. Although since then, a large number of reports have been published on both the La(Ba/Sr)CuO/sub 4/ and YBa/sub 2/Cu/sub 3/O/sub x/ systems, one indication of concern regarding possible uses of these new superconductors in high magnetic fields is the fact that the reported values of critical current density J/sub c/ are very low, e.g., the best value of J/sub c/ for YBa/sub 2/Cu/sub 3/O/sub x/ is —11 A/mm/sup 3/ at 77 K. This value is at least 2 to 3 order of magnitude lower than what is required for possible high field applications. In order to investigate the factors which influence the values of J/sub c/ in these oxides, the authors measures the magnetization for a number of well-characterized specimens of La/sub 1.85/Sr/sub 0.15/CuO/sub 4/ and YBa/sub 2/Cu/sub 3/O/sub x/ where X—6-7, and preliminary results are summarized here.

43603 Electron tunneling measurements in LaSrCuO and YBaCuO. Moreland, J.; Ekin, J.W.; Clark, A.F.; Goodrich, L.F.; Capobianco, T.E. (NBS, Boulder, CO). pp 273-276 of Proceedings of symposium S at the 1987 Spring meeting of the MRS on high temperature superconductors (Extended Abstracts). Gubser, D.U.; Schluter, M. Pittsburgh, PA; Materials Research Society (1987). (CONF-870438—).

From Spring meeting of the Materials Research Society; Anaheim, CA, USA (21 Apr 1987).

The authors analyze the break junction technique, whereby vacuum tunneling occurs within the fracture of a bulk sample to study the LaSrCuO and YBaCuO perovskite superconductors. Structure in the current-versus-voltage characteristics is reminiscent of previous quasiparticle curves obtained for BCS superconducting materials. Some curves have anomalous qualities, including large dips in the junction conductance with increasing voltage just above a well defined tunneling gap edge, linearly increasing junction conductance with applied bias, features occurring near 1, 3, 5 voltage intervals.

43604 Critical performance of ceramic processed YBa/sub 2/Cu/sub 3/O/sub 7/ materials. Capone, D.W. II; Flandermeyer, B. (Argonne National Lab., Argonne, IL). pp 181-184 of Proceedings of symposium S at the 1987 Spring meeting of the MRS on high temperature superconductors (Extended Abstracts). Gubser, D.U.; Schluter, M. Pittsburgh, PA; Materials Research Society (1987). (CONF-870438—). Contract W-31-109-ENG-38.

From Spring meeting of the Materials Research Society; Anaheim, CA, USA (21 Apr 1987).

The discovery of the YBa/sub 2/Cu/sub 3/O/sub 7/ high-T/sub c/ superconductor has sparked a tremendous interest, both in scientific and popular circles, in superconductivity applications at liquid nitrogen temperatures (65-77K). In this paper the authors present a summary of the present status of the conductor development program and point out those areas where short-term effort will be expended in order to improve the critical current densities of these materials.

43605 Superconductivity and phase stability in the heavy rare earth quaternary compounds RBa/sub 2/Cu/sub 3/O/sub 7/ (R = Ho, Er, Tm, Yb, Lu). Ku, H.C.; Yang, H.D.; McCallum, R.W.; Noack, M.A.; Klavins, P.; Shelton, R.N.; Moodenbaugh, A.R. (Ames Lab., USDOE and Dept. of Physics, Iowa State Univ., Ames, IA). pp 177-180 of Proceedings of symposium S at the 1987 Spring meeting of the MRS on high temperature superconductors (Extended Abstracts). Gubser, D.U.; Schluter, M. Pittsburgh, PA; Materials Research Society (1987). (CONF-870438—). Contract W-7405-ENG-82.

From Spring meeting of the Materials Research Society; Anaheim, CA, USA (21 Apr 1987).

Superconductivity in the Lu-Ba-Cu-O system with transition temperature T/sub c/ near 90 K is reported in the multiphase compound Lu/sub 1.8/Ba/sub 0.2/CuO/sub 4/. The superconducting phase is quickly identified as the composition LuBa/sub 2/Cu/sub 3/O/sub 6+1/ ($x \simeq 1$) and isostructural to the high T/sub c/ YBa/sub 2/Cu/sub 3/O/sub 7/- type structure, which is first reported in the multiphase compound Y/sub 1.2/Ba/sub 0.8/CuO/sub 4/. LuBa/sub 2/Cu/sub 3/O/sub 7/ has a perovskite-like orthorhombic structure and is the heaviest rare earth (R) compound in the whole superconducting family RBa/sub 2/Cu/sub 3/O/sub 7/. In this paper, the authors report the results of a phase stability study and superconducting properties of heavy rare earth compounds RBa/sub 2/Cu/sub 3/O/sub 7/ (R = Ho, Er, Tm, Yb, Lu).

43606 Preparation and properties of high T/sub c/ superconducting ceramics. Aselage, T.L.; Bunker, B.C.; Doughty, D.H.; Eatough, M.O.; Hammetter, W.F.; Keefer, K.D. (Sandia National Labs., Albuquerque, NM). pp 157-160 of Proceedings of symposium S at the 1987 Spring meeting of the MRS on high temperature superconductors (Extended Abstracts). Gubser, D.U.; Schluter, M. Pittsburgh, PA; Materials Research Society (1987). (CONF-870438—).

From Spring meeting of the Materials Research Society; Anaheim, CA, USA (21 Apr 1987).

This research study on high T/sub c/ superconductors is directed toward problems common to electronic ceramics: synthesis of reactive starting powders; formation of dense films and bulk ceramics; control of composition, microstructure, and defect state during firing; and determining how process variables affect the electronic properties of the ceramic so the desired properties are obtained. The authors choose to study La/sub 1.8/Sr/sub 0.2/CuO/sub 4/ (T/sub c/ =40K) and Y Ba/sub 2/Cu/sub 3/O/sub 7/ (T/sub c/ =92K) as representative of the general family of copper oxide-based superconducting ceramics. All areas of study are seeing equal progress in the short time of the program.

43607 **Superconductivity above 90K in rare-earth R barium copper oxides RBa/sub 2/Cu/sub 3/O/sub 9-δ/.** Yang, K.N.; Dalichaouch, Y.; Ferreira, J.M.; Hake, R.R.; Lee, B.W.; Maple, M.B.; Neumeier, J.J.; Torikachvili, M.S.; Zhou, H. (Univ. of California, San Diego, La Jolla, CA). pp 77-80 of Proceedings of symposium S at the 1987 Spring meeting of the MRS on high temperature superconductors (Extended Abstracts). Gubser, D.U.; Schluter, M. Pittsburgh, PA; Materials Research Society (1987). (CONF-870438—).

From Spring meeting of the Materials Research Society; Anaheim, CA, USA (21 Apr 1987).

Superconductivity above 90K is found in the RBa/sub 2/Cu/sub 3/O/sub 9-δ/ compounds where R = Nd, Sm, Eu, Gd, Dy, Ho, Er, Tm, Yb, and Lu. All these compounds are prepared in the perovskite-type structure for YBa/sub 2/Cu/sub 3/O/sub 9-δ/. The width and onset temperature of the resistive transitions to the superconducting state, as well as the temperature dependence of the resistivity in the normal phase are very sensitive to the synthesis method employed in all the compounds. For R = Sm, Eu, and Gd the resistive superconducting transitions widths are substantially reduced and the sign of ∂rho/∂T in the normal state changes from negative to positive upon compaction so as to increase the sample density.

43608 **Bonds, bands, charge transfer excitations and superconductivity of the new low dimensional superconductors.** Freeman, A.J.; Fu, C.L.; Koelling, D.D.; Massidda, S.; Watson-Yang, T.J. (Northwestern Univ., Evanston, IL). pp 27-30 of Proceedings of symposium S at the 1987 Spring meeting of the MRS on high temperature superconductors (Extended Abstracts). Gubser, D.U.; Schluter, M. Pittsburgh, PA; Materials Research Society (1987). (CONF-870438—).

From Spring meeting of the Materials Research Society; Anaheim, CA, USA (21 Apr 1987).

The authors have carried out extensive high precision, high resolution calculations of the electronic structure and properties of La/sub 2-x/M/sub x/CuO/sub 4/ and YBa/sub 2/Cu/sub 3/O/sub 7/-δ using an all-electron state of the art local density approach. These provide important information about the properties of the superconducting materials and provide insight into the possible underlying mechanism of their observed high temperature superconductivity. This paper gives a very brief summary of the results obtained.

3606 Other Materials

REFER ALSO TO CITATION(S) 43078, 43119, 43140, 43148, 43157, 43299, 43529, 43539, 43569, 43569, 43574, 43743, 43791, 44035, 44617, 44741

43609 **(AD-A—180874/0/XAB) Structural effects on the electrochemical behavior of redox couples incorporated in electrode coatings prepared from copolymers and composites.** Inoue, T.; Anson, F.C. (California Inst. of Tech., Pasadena (USA). Arthur A. Noyes Lab. of Chemical Physics). 1987. 8p. NTIS, PC A02/MF A01.

Pub. in Jnl. of Physical Chemistry, Vol. 91, No. 6, 1519-1525(1987).

Five new random vinyl copolymers were prepared and tested as coating materials for binding redox active ions to electrode surfaces. Three of the copolymers were polycationic because of quaternary nitrogen sites. Two uncharged copolymers were used to prepare polycationic coatings by mixing with selected homopolymers, poly(4-vinylpyridine); poly(N-vinyl-2-methylimidazole); poly(4-vinylbenzyldiethylamine), that became polycationic by protonation at the pH where they were employed (4.5). Coatings with the most attractive properties for incorporating and retaining Fe(CN)6(4-) anions were prepared from mixtures of the polycationic copolymers with poly(4-vinylpyridine). The presence of alkyl benzyl either groups in the copolymers was shown to enhance their desirable properties as electrode coatings. Transmission-electron micrographs of coatings revealed some correlation between their internal morphologies and their electrochemical behavior.

43610 **(AD-A—180913/6/XAB) Densities and mobilities of coexisting electrons and holes in GaSb/InAs/GaSb quantum wells.** Munekata, H.; Mendez, E.E.; Iye, Y.; Esaki, L. (International Business Machines Corp., Yorktown Heights, NY (USA). Thomas J. Watson Research Center). 1986. 6p. NTIS, PC A02/MF A01.

Pub. in Surface-Science, Vol. 174, 449-453(1986).

Quantum wells of gallium antimony/indium arsenide were prepared by molecular beam epitaxy (MBE) with emphasis on the correlation of the growth parameters with their electronic properties as characterized by magnetotransport measurements. An electron mobility of 350,000 sq cm/V were obtained for the first time in the presence of holes. The holes disappear at a critical InAs thickness around 60 A resulting from a semimetal-semiconductor transition.

43611 **(AD-A—181245/2/XAB) Synthetic metals from intercalated graphite. Semi-annual report No. 5, 1 October 1986-31 March 1987.** Dresselhaus, M.S.; Dresselhaus, G. (Massachusetts Inst. of Tech., Cambridge (USA). Center for Materials Science and Engineering). 11 May 1987. 12p. NTIS, PC A02/MF A01.

During the six-month period October 1, 1986 - March 31, 1987, efforts on the Program Synthetic Metals from Intercalated Graphite were largely focused on studies of magnetic and superconducting graphite intercalation compounds. A summary of the accomplishments of the research program is presented.

43612 **(AD-A—181256/9/XAB) Evaluation of resins cured by ultraviolet radiation and in conjunction with fiber-optic systems for use in the field repair of composite materials. Final report.** Sennett, M.S.; Wentworth, S.E. (Army Materials Research Agency, Watertown, MA (USA). Materials Technology Lab.). Mar 1987. 16p. (MTL-TR—87-15). NTIS, PC A02/MF A01.

Several commercially available resins designed to be cured with ultraviolet radiation were evaluated with respect to their potential for use in the field repair of composite materials. Thermal and mechanical properties of cured resins were evaluated by DSC and TBA techniques. Some cured resins exhibited physical properties that may be suitable for repair application. None of the tested materials was able to cure when impregnated in woven graphite cloth which strongly attenuates the curing radiation. This prevented the use of fiber optics to cure these systems.

43613 **(AD-B—955852/9/XAB) Advanced development on vulnerability/survivability of advanced composite structures. Interim report No. 2, 16 June-15 September 1971.** Clark, H.T. (McDonnell Aircraft Co., St. Louis, MO (USA)). 15 Oct 1971. 52p. (MDC-A—1408). NTIS, PC A04/MF A01.

Distribution limitation now removed.

43614 **(AD-B—955853/7/XAB) Advanced development on vulnerability/survivability of advanced composite structures. Interim report No. 3, 16 September-15 December 1971.** Clark, H.T. (McDonnell Aircraft Co., St. Louis, MO (USA)). 15 Jan 1972. 77p. (MDC-A—1530). NTIS, PC A05/MF A01.

Distribution limitation now removed.

43615 **(AD-B—955854/5/XAB) Advanced development on vulnerability/survivability of advanced composite structures. Interim report No. 4, 16 December-15 March 1972.** Clark, H.T. (McDonnell Aircraft Co., St. Louis, MO (USA)). 15 Apr 1972. 56p. (MDC-A—1673). NTIS, PC A04/MF A01.

Distribution limitation now removed.

43616 **(AD-B—955855/2/XAB) Advanced development on vulnerability/survivability of advanced composite structures. Interim report No. 5, 16 March-15 June 1972.** Clark, H.T. (McDonnell Aircraft Co., St. Louis, MO (USA)). 15 Jul 1972. 92p. (MDC-A—1791). NTIS, PC A05/MF A01.

Distribution limitation now removed.

43617 (AD-B—955856/0/XAB) Advanced development on vulnerability/survivability of advanced composite structures. Interim report No. 6, 16 June-15 September 1972. Clark, H.T. (McDonnell Aircraft Co., St. Louis, MO (USA)). 15 Oct 1972. 97p. (MDC-A—1971). NTIS, PC A05/MF A01.

Distribution limitation now removed.

43618 (BNL—39873) Adhesion properties of polyelectrolyte-chemisorbed zinc phosphate conversion coatings. Sugama, T. (Brookhaven National Lab., Upton, NY (USA)). May 1987. Contract AC02-76CH00016. 38p. (CONF-870410—14-Rev.). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012489.

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

The outermost surface sites of polyelectrolyte complexed crystalline zinc phosphate (Zn . Ph) layers precipitated on cold-rolled steel surfaces act significantly to promote interfacial adhesive bonding to polymeric topcoats. This is the result of electrostatic internal diffusion and segmental chemisorption mechanisms of polyelectrolyte macromolecules either on newly precipitated crystal nuclei or on crystal growth sites during the primary Zn . Ph conversion process. The nature of the polymer-to-polymer chemical bond produced at the polymer-to-polymer complex Zn . Ph adherend interfacial joints plays the key role in the achievement of long-term bond durability upon exposure to chemically corrosive environments.

43619 (CONF-8706152—3) Direct formation of thin films and epitaxial overlayers at low temperatures using a low-energy (10-500 eV) ion beam deposition system. Zuhr, R.A.; Alton, G.D.; Appleton, B.R.; Herbots, N.; Noggle, T.S.; Pennycook, S.J. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012291.

From European Materials Research Society conference; Strasbourg, France (2 Jun 1987).

A low-energy ion beam deposition system has been developed at Oak Ridge National Laboratory and has been applied successfully to the growth of epitaxial films at low temperatures for a number of different elements. The deposition system utilizes the ion source and optics of a commercial ion implantation accelerator. The 35 keV mass- and energy-analyzed ion beam from the accelerator is decelerated in a four-element electrostatic lens assembly to energies between 10 and 500 eV for direct deposition onto a target under UHV conditions. Current densities on the order of 10 $\mu A/cm^2$ are achieved with good uniformity over a 1.4 cm diameter spot. The completed films are characterized by Rutherford backscattering, ion channeling, cross-section transmission electron microscopy, and x-ray diffraction. The effects of substrate temperature, ion energy, and substrate cleaning have been studied. Epitaxial overlayers which show good minimum yields by ion channeling (3 to 4%) have been produced at temperatures as low as 375°C for Si on Si(100) and 250°C for Ge on Ge(100) at growth rates that exceed the solid-phase epitaxy rates at these temperatures by more than an order of magnitude.

43620 (CONF-8706171—1) Si-SiO_2 interfaces: A HRTEM [High Resolution Transmission Electron Microscopy] study. Ravindra, N.M.; Fathy, D.; Holland, O.W.; Narayan, J. (Vanderbilt Univ., Nashville, TN (USA); Oak Ridge National Lab., TN (USA); North Carolina State Univ., Raleigh (USA)). 1987. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87012255.

From Meeting on the physics and technology of amorphous SiO/sub 2/; Les Arcs, France (29 Jun 1987).

A High Resolution Transmission Electron Microscopy (HRTEM) study of the Si-SiO_2 interfaces is reported here. The study has been carried out on the thermal oxidation of (1) Si and (2) Ge implanted Si. Evolution of the Si-SiO_2 interface with oxide thickness and the presence of small amounts of Ge, i.e., one monolayer at the interface and its influence on the oxidation kinetics is discussed.

43621 (DME—07) Artificial composites for high temperature applications: a review. Islam, M.U.; Wallace, W.; Kandeil, A.Y. (National Research Council of Canada, Ottawa, Ontario). Jan 1987. 84p. (NRC—27323). NTIS, PC A05/MF A01.

A review is provided of developments in artificial, metal and ceramic matrix composites with potential for high temperature applications such as in the hot sections of gas turbine engines. Emphasis is placed on developments which have occurred since 1975. An attempt is made to assess the current level of activity and to identify outstanding problems and research directions for the future. To provide a basis for these discussions, the status prior to 1975 is also briefly reviewed.

43622 (DOE/ER/45283—T1) X-ray studies of strain, interface and impurity in semiconductors: Technical progress report for the period November 1, 1986 to July 31, 1987. Kao, Yi-Han. (State Univ. of New York, Stony Brook (USA). Dept. of Physics). 1987. Contract FG02-87ER45283. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013856.

Residual strains were measured in As-implanted Si and SiO_2 Si heterostructures. Interfacial roughness and surface roughness were measured in several heterostructures. High-temperature superconductors (Y-Ba-Cu-O) are being studied. Wavelength-modulated x-ray spectroscopy is being developed. (DLC)

43623 (HEDL-SA—3677) Swelling of lithium ceramics during irradiation. Hollenberg, G.W. (Hanford Engineering Development Lab., Richland, WA (USA)). Feb 1987. Contract AC06-76FF02170. 19p. (CONF-870422—7). NTIS, PC A02/MF A01. File Number DE87009971.

From 89. annual meeting of the American Ceramic Society; Pittsburgh, PA, USA (26 Apr 1987).

Lithium ceramics are being considered for the purpose of tritium production in D to T fusion power plants. One of the many issues which must be resolved before blankets containing lithium ceramics are brought into service is the degree of stability which can be expected from these new materials. Swelling of the solid breeder material can directly impact the design lifetime of the blanket. Accommodation of swelling in the design can correspondingly require compromises in the overall performance of the blanket. Recently, an irradiation experiment was completed at moderate burnup levels in which swelling of solid breeder materials was observed. As will be discussed, the swelling of the Li_2O can be considerably more than that of the Li_4SiO_4. Li_2ZrO_3 and $LiAlO_2$. In addition, a degree of pellet cracking and fragmentation was observed which varied between the materials.

43624 (IS-T—1280) Investigation of non-magnetic iron in $Lu_2Fe_3Si_5$-type superconductors. Xu, Youwen. (Ames Lab., IA (USA)). Aug 1987. Contract W-7405-ENG-82. 102p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87013602.

A study on the effect of transition metal substitution for Fe in the compounds $Lu_2(Fe/sub\ 1-x/T/xub\ x/)_3Si_5$ (T=Cr, Mn, Co, Ni, Cu, and Ru) is reported. The effect of these transition metals on the superconducting transition temperature shows that Cr, Co, Ni and Ru all act as nonmagnetic impurities. Good agreement with Kaiser's theory is obtained. Rate of suppression due to Co substitution is similar to that of Ru. Superconductivity persists (T/sub c/ =0.49K) even when 10 at .% Co is substituted for Fe. Mn and Cu act as magnetic impurities. The molar magnetic susceptibility of $Lu_2Fe_3Si_5$ does not follow a Curie-Weiss law, but rather increases slightly with temperature. Addition of Ru lowers the value of chi(T), but the overall shape of chi(T) is unchanged. In contrast, substitution of Cr, Mn, Co and Ni for Fe causes chi(T) to become more Curie-Weiss like. The magnetic susceptibility of $Lu_2Co_3Si_5$ follows the Curie-Weiss law, while that of the compound $Lu_2Ru_3Si_5$ is diamagnetic. The electrical resistivity rho(T) of $Lu_2Fe_3Si_5$ is quadratic in T below 50°K and proportional to 1nT above 100 K. The low temperature heat capacity data of the Co- and Ru-containing samples both fit to equations $\gamma/sub\ s/T+\beta/sub\ s/T^3$ below T/sub c/ and $\gamma/sub\ n/T+\beta/sub\ n/T^3+\alpha/sub\ n/T^5$ above T/sub c/. Increasing the concentration of Co or Ru lowers

the Debye temperature and the electronic density of states at the Fermi level of the compounds and enhances the linear term in the superconducting state heat capacity. The reduced specific heat jump between C/sub s/ and C/sub n/ at T/sub c/ follows neither the BCS prediction nor the Abrikosov and Gor'kov's theory.

43625 **(IS-T—1336) Use of sol-gels in the application of ceramic oxide thin films.** Paulson, B.A. (Ames Lab., IA (USA)). Aug 1987. Contract W-7405-ENG-82. 93p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87013610.

Single components sols were characterized and used to make thin films on silicon wafers. The empirical equation, d = (2000 log(μ) + 350)(w)/sup -0.5/, was obtained, which adequately describes the thickness of the sintered films, independent of the ceramic oxide, solvent, concentration, sol age, and reaction conditions. The single component sols were used to make binary oxide sols - barium titanate, lithium niobate, and lithium tantalate. A barium solution can be added to the titania sol to produce a barium titanate compound of the desired composition, including $Ba_2Ti_9O_{20}$ and $BaTi_5O_{11}$. Mixing a lithium solution into either a niobia or a tantala sol yielded the desired compound along with a heavy metal oxide (either lithium niobate with niobium oxide or lithium tantalate with tantalum oxide). However, dissolving lithium methoxide with the ethoxide of niobium or tantalum in ethanol, prior to hyrolysis, did produce the desired binary oxide (lithium niobate or lithium tantalate) without any uncombined metal oxide. By altering the stoichiometric ratios of the constituent cations, different compounds were produced for dielectric characterization with an AC bridge circuit. In the case of the barium titanates, these calculated constants ranged from a high of 26.0 for TiO_2, to a low of 11.9 for $BaTi_5O_{11}$. The range for lithium tantalate was from a high of 21.6 for a stoichimetry of Li_7TaO_6, to a low at 8.4 for $LiTaO_3$. Lithium niobate ranged from a high at 21.1 for Nb_2O_5, to a low at 8.9 for Nb_2O_5 at a stoichimetry of $Li_2Nb_{32}O_{81}$.

43626 **(JAERI-M—87-048) Electron beam irradiation effects on carbon fiber reinforced PEEK composite.** Sasuga, Tsuneo; Hagiwara, Miyuki; Odajima, Tosikazu; Sakai, Hideo; Nakakura, Toshiyuki; Masutani, Masahiro. (Japan Atomic Energy Research Inst., Tokyo). Mar 1987. 34p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. File Number DE87753001.

Carbon fiber(CF) reinforced composites, using polyarylether-sulfone (PES) or polyarylether-ether-ketone (PEEK) as matrix material, were prepared and their electron beam irradiation effects were studied on the basis of changes in mechanical and dynamic viscoelastic properties and observation of fracture surfaces. The flexural strength of PES-CF composite decreased to 70 % of the initial strength after the irradiation of 3 MGy and 40 % after 15 MGy. The change in the profile of stress-strain (S-S) curves and fractographic observation by electron microscopy indicated that this composite irradiated with over 3 MGy was fractured by delamination caused by to the degradation of matrix polymer. The mechanical properties of PEEK-CF composite were scarcely decreased even after irradiated up to 180 MGy and this composite showed very high radiation resistance. The change in the profile of S-S curves and fractographic observation showed that this composite fractured due to destruction of fiber in the dose range less than 180 MGy, indicating that PEEK was excellent matrix material used in high radiation field. PEEK-PES-CF composite which was composed of the carbon fibers coated with PES solution showed less radiation resistance compared with PEEK-CF composite; the flexural strength decreased to 85 % of the initial value after the irradiation with 90 MGy. It was revealed from the changes in the profile of S-S curve that the specimen irradiated over 120 MGy was fractured due to not only fiber destruction but delamination. Deterioration mechanism of PEEK-PES-CF composite was studied by dynamic viscoelastic measurements in connection with the damage on matrix-fiber interface. It was suggested that the deterioration in mechanical properties of this composite was caused by the degradation of PES that coated on the surface of the carbon fibers.

43627 **(LA—11058-MS) SESAME equation of state number 7411, Al_2O_3.** Barnes, J.F.; Lyon, S.P. (Los Alamos National Lab., NM (USA)). Aug 1987. Contract W-7405-ENG-36. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012694.

A new global equation of state for Al_2O_3 ("alumina") has been constructed and placed on the SESAME Library as material number 7411.

43628 **(LA-UR—87-2121) Luminescence from self-trapped holes in manganese-doped calcium fluoride single crystals.** Jahan, M.S.; Cooke, D.W.; Alexander, C. Jr. (Memphis State Univ., TN (USA). Dept. of Physics; Los Alamos National Lab., NM (USA); Alabama Univ., University (USA). Dept. of Physics and Astronomy). 1987. Contract W-7405-ENG-36. 3p. (CONF-8708100—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87011748.

From International conference on luminescence; Beijing, China (17 Aug 1987).

Thermally stimulated luminescence (TSL) and electron spin resonance (ESR) measurements on x-irradiated CaF_2:Mn (0.1 wt %) single crystals have been conducted in the interval 70 to 300 K. Prominent TSL peaks occur near 150 K (345- and 495-nm emission) and 200 K (predominantly 495-nm emission) with thermal decay of ESR centers at these same temperatures. Taken collectively the data suggest that 150 K TSL emission is due to mobile holes from V/sub K/ centers recombining with both trapped electrons and Mn^+ ions, i.e., V/sub K/ + $e^- \rightarrow$ 345-nm emission, and V/sub K/ + $Mn^+ \rightarrow (Mn^{2+})^*$ + hv (495-nm emission). Additionally, H centers are formed by transformation of V/sub K/ centers. At 200 K, holes from H centers recombine with Mn^+ to produce excited-state $(Mn^{2+})^*$ which decays by emitting 495-nm radiation.

43629 **(LBL—23492) Energy spectra of shallow donors and acceptors in GaAs/sub 1-x/Al/sub x/As superlattices.** Oliveira, L.E.; Falicov, L.M. (Lawrence Berkeley Lab., CA (USA); Universidade Estadual de Campinas (Brazil). Inst. de Fisica). Jun 1987. Contract AC03-76SF00098. 9p. (CONF-870276—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014120.

From 3. Brazilian school of semiconductor physics; Campinas, Brazil (16 Feb 1987).

The energy spectra of shallow donors and acceptors in GaAs-Ga/sub 1-x/Al/sub x/As quantum-well structures have been calculated. The binding energies of the impurities were obtained within a variational calculation in the effective-mass approximation. Calculations were performed for various types of impurity as functions of the position of the impurity in a GaAs quantum well of infinite depth and for various slab thicknesses. The effect of the spatially dependent screening is modeled with a function of the form $\epsilon^{-1}(r) = \epsilon_0^{-1} + (1 - \epsilon_0^{-1})\, e/sup\ -r/a/$, with a screening parameter a $\simeq$1.1 a.u. characteristic of bulk GaAs. Results are compared with Bastard's theory, which is based on a constant ϵ_0 screening, and it is found that spatially dependent screening effects can be quite important for all acceptors in GaAs quantum wells over a large range of slab thicknesses. Calculated results with improved statistics are in quantitative agreement with experimental data.

43630 **(LBL—23522) Formation of Nb_3Al in powder processed Nb-Al superconductors.** Johnson, P.E. (Lawrence Berkeley Lab., CA (USA)). May 1987. Contract AC03-76SF00098. 51p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87012889.

In high magnetic fields, the critical current density is strongly dependent on the upper critical field, which is determined primarily by the stoichiometry of the Nb_3Al. The critical temperature (T/sub c/), like the upper critical field, is considered to be a measure of the "intrinsic" quality of the superconductor, indicating the stoichiometry, order, and strain. If the A15 phase is stoichiometric and well ordered, a high T/sub c/ (and high H/sub C_2/) is expected, regardless of the volume fraction of superconductor. On the other hand, if sigma phase is present with the A15, the resultant composition gradient across the sigma-A15 interface(s) requires that some of the A15 be off-stoichiometric, and therefore that the T/sub c/ (and H/sub C_2/) be low. Thus the extent of the A15 (Nb_3Al) reaction and the quality of the A15 formed are interdependent. This work focuses on the factors that control the extent of Nb_3Al formation in Nb/Al powder wires. The morphology and content of the reacted and unreacted wires are studied in optical, SEM, and TEM micrographs. Critical current density data and its dependence on processing are explained in terms of the unreacted microstructure

and its effect on the extent of Nb_3Al formation. As a method of improving the critical current density, a new variation of the conventional powder process for wire manufacturing is developed and tested.

43631 (N—87-22244) Lubrication properties of molybdenum disulfide films deposited by RF sputtering method. Nishimura, M.; Nosaka, M.; Suzuki, M.; Seki, K.; Miyakawa, Y. (National Aerospace Lab., Chofu, Tokyo (Japan)). 1986. 64p. (NAL-TR—903). NTIS, PC A04/MF A01.

A radio frequency sputtering apparatus with a pair of targets has been developed for depositing a film of uniform thickness onto a complex-geometric specimen such as the retainer of a ball bearing. The deposition characteristics of the apparatus were compared with those of the conventional sputtering apparatus. Lubrication properties of MoS_2 films made by these devices were also compared under a variety of conditions. Finally, friction and wear of MoS_2 films applied to angular-contact type ball bearings of 20 mm bore were studied in air, nitrogen and vacuo. The two-target sputtering has an advantage mentioned above. However, the films deposited by the method exhibited a rather short wear life because of the temperature rise of the substrate during ion bombardment and during the sputtering process. This temperature dependence was observed in films on those substrates that had been heated with a built-in heater during sputtering. The film thickness measurement and the observation by an electron microscope showed this was attributed to the porous growth of films. Thus substrates should be kept at low temperatures when one wants to obtain a MoS_2 film of high quality. As a whole, sputtered MoS_2 are an excellent lubricant under sliding contact as well as rolling contact conditions in regard to friction force and endurance life.

43632 (N—87-23304) AlGaAs growth by OMCVD using an excimer laser. Warner, J.D.; Wilt, D.M.; Pouch, J.J.; Aron, P.R. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Dec 1986. 11p. (CONF-861207—113; NASA-TM—88937; E—3379; NAS—1.15:88937). NTIS, PC A02/MF A01.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

AlGaAs has been grown on GaAs by laser assisted OMCVD using an excimer laser, wavelength 193 nm, and a Cambridge OMCVD reactor. Films were grown at temperatures of 450 and 500 C with the laser beam parallel to the surface and impinging onto the surface at 15 deg from parallel. The samples were heated by RF coils while the laser beam was perpendicular to the gas flow. Typical gas flow parameters are 12 slm of H_2, 15 sccm of Ga(CH3)3, 13 sccm of Al(CH3)3, and a pressure of 250 mbar. The initial energy density of the beam at the surface was 40 mJ/sq cm, the pulse rate was 20 pps, and the growth time was 7 min. The films were analyzed by Auger electron spectroscopy for the aluminum concentration and by TEM for the surface morphology.

43633 (SAND—87-1213C) Characterization of plasma-deposited amorphous carbon films. Hsu, W.L.; Foltz, G.W.; Greulich, F.A.; McCarty, K.F.; Thomas, G.J.; Green, P.F.; Doyle, B.L. (Sandia National Labs., Livermore, CA (USA); Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 13p. (CONF-870438—33). NTIS, PC A02/MF A01; GPO Dep. File Number DE87014171.

From Spring meeting of the Materials Research Society; Anaheim, CA, USA (21 Apr 1987).

Thin carbon films of ~600 A have been deposited on Si <111> wafers by striking an rf discharge in gas mixtures of hydrogen and methane. The deposition rate increased with increasing methane fraction. The peak rate was ~1 A/sec at an applied power density of 0.4 W cm^{-2}. The films, with an average density of 2.54 gm cm^{-3}, are amorphous in nature but exhibit broad diffraction maxima corresponding to interplanar spacings of 2.05A and 1.15A. Measurements of hydrogen concentration in the films showed that the hydrogen at. % increased from 30% to 40% as the hydrogen fraction in the feed gas increased. By using a D_2-CH_4, we were also able to deduce that hydrogen molecules can be a large source of hydrogen trapped in the films.

43634 (SAND—87-1883C) Understanding the transport properties of silicon grain boundaries and how they relate to I.C. applications of polysilicon. Seager, C.H. (Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 26p. (CONF-8611185—1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013809.

From Silicon material research symposium; Hsin-Chu, Taiwan (28 Nov 1986).

Silicon integrated circuit technology utilizes polycrystalline silicon (polysilicon) for a variety of purposes ranging from gates and conductor lines to resistors and, recently, even active devices. The structural, chemical, and electrical properties of silicon grain boundaries play a fundamental role in determining the operational characteristics of these polysilicon elements. In many cases process control problems, such as the extreme sensitivity of poly resistivity to dopant level variations, can be traced directly back to the fundamental nature of the double depletion layers that surround most silicon grain boundaries. In the past 10 years studies of the fundamental transport properties of single grain boundaries have provided us with a clear theoretical picture for predicting the current flow across such structures. Our present state of understanding in this area is reviewed. Despite this level of progress, predicting the electrical properties of a real polycrystalline film remains a difficult task. Inhomogeneities in the structure of single boundaries, crystallographic dependence of potential barrier heights, grain boundary dopant segregation and diffusion, plus other effects are the source of the complex properties of a typical real-world polysilicon device.

43635 (SAND—87-8224) Polystyrene characterization by proton energy loss Monte Carlo distributions. Antolak, A.J. (Sandia National Labs., Livermore, CA (USA)). Aug 1987. Contract AC04-76DP00789. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014266.

Several Monte Carlo models have been used to characterize polymer materials in order to relate the experimental proton energy loss (PEL) spectra to the determination of (electron) density and material morphology. We have derived analytic expressions for the average material thickness and the standard deviation corresponding to these numerical models. Additionally, the exact expressions for the standard deviation were reduced to simpler forms via a Taylor series expansion. The equations give insight into the functional dependence of the measured spectral results in terms of the fundamental properties of the materials.

43636 (TNO-HMT—85-02386) Application of AFBC-ash as partial replacement for sand and lime in sand-lime bricks. Gerritsen, R. (Hoofdgroep Maatschappelijke Technologie TNO, Apeldoorn (Netherlands)). Feb 1985. 28p. (In Dutch). Hoofdgroep Maatschappelijke Technologie TNO, P.O. Box 342, 7300 AH Apeldoorn, Netherlands.

Possible application of AFBC-ash in sand-lime bricks has been investigated. To this extent a couple of baghouse ashes has been used to replace 1-40% sand and a bedash to replace 0-50% lime. In the sand-lime brick process sand, lime and water are mixed and pressed to bricks or building-blocks after a certain reaction time. Then metalling takes place in an autoclave, at a steam pressure of 8-12 bar and a temperature of 180-200 C for 4-6 hours. Sand-lime bricks and -blocks are used particularly for building innerwalls of buildings. The annual production is about 3.8 million tons of sand-lime bricks (3.5 million tons of sand and 0.3 million tons of lime). Sand has been replaced by two types of AFBC-bag house ashes having different carbon contents (18 and 28% carbon). The following replacement percentages were used: 1, 5, 10, 20 and 40%, at a lime content of 6% CaO. With these mixtures tablets have been made which are tested for a.o. swell and compressive strength. Even with small replacement percentages the compressive strength appeared to fall drastically, and at the same time a strong increase of swell and rupture was observed. Causes of these disappointing results must be sought in a mixture preparation which was not suitable for this raw material mixture, reaction time before pressing, which has been too short, and in the properties and ratio of baghouse ashes and bedash. For replacement of lime AFBC-bedash has been used with a CaO-percentage as high as possible; replacement percentages: 8, 15, 23 and 31% (basic lime percentage: 6.5% CaO). Replacing lime by AFBC-bedash is coupled with replacing part of the sand fraction by 'real ash particles' in the

bedash. These experiments have also given disappointing results which can partly be reduced to the same causes as indicated at the replacement of sand. Besides it seems also necessary to grind the bedash more finely in order to make the present CaO better available. 1 fig., 1 tab., 1 ref.

43637 **(UCRL—95340) Rheological behaviors of an elastomeric membrane.** Feng, W.W. (Lawrence Livermore National Lab., CA (USA)). Sep 1986. Contract W-7405-ENG-48. 3p. (CONF-870533—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013105.

From 11. Canadian congress of applied mechanics; Edmonton, Canada (31 May 1987).

In this paper, the nonlinear viscoelastic membrane mechanics have been formulated, solved, and experimentally verified for the inflation of an initially flat thin circular membrane. With some minor modifications on these formulations, the whole class of axisymmetric viscoelastic membrane problems can be studied. In the formulation, the geometric nonlinearity as well as the material nonlinearity are included. The theoretical value for the strains can be as large as needed; for practical applications, however, these values are limited by the fracture strength and are usually less than a few hundred percent. In the formulation, the relaxation function is represented by a single exponential term that does not represent the material properties in reality. However, the formulation presented here can be extended to a more realistic relaxation function which is represented by a series of exponential functions or by the power law. The analytical results combined with the experimental results can be used further to determine the material properties of elastomers, g_0 and $g_1(t)$.

43638 **(UCRL—96435) Theory of the carbon phase diagram at high pressures and temperatures.** Young, D.A.; Grover, R. (Lawrence Livermore National Lab., CA (USA)). Jul 1987. Contract W-7405-ENG-48. 6p. (CONF-870753—20). NTIS, PC A02. File Number DE87012245.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

Despite the great technological and scientific importance of graphite and diamond, the carbon phase diagram is poorly understood. Developed here is a simple theoretical model for the prediction of this diagram at very high pressures. The diamond melting curve has a positive dP/dT slope, and that solid diamond has a very large stability field.

43639 **(UNI-SA—207) Oxidation of TSX graphite over the temperature range 450 to 1200°C.** Bunnell, L.R.; Campbell, T.K.; Tingey, G.L. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1987. Contract AC06-76RL01857;AC06-76RL01830. 8p. (PNL-SA—14925; CONF-870796—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012230.

From 63. biennial carbon conference; Worcester, MA, USA (19 Jul 1987).

In the past, studies have been performed on the oxidation of many grades of graphite over a wide temperature range. The accident at Chernobyl and subsequent analysis of the N Reactor prompted interest in obtaining data on the oxidation rate of TSX graphite, the type from which N Reactor was built. Work has concentrated on oxidation of TSX graphite by air at temperatures from 450 to 1200°C. Oxidation is determined by density measurements. Experimental results are presented.

43640 **Diamond like carbon high-temperature diffusion barrier for copper-gasketed stainless-steel flanges.** Nyaiesh, A.R.; Garwin, E.L.; Hoyt, E.W. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **5**: No. 5, 2977-2977(Sep 1987). Contract AC03-76SF00515.

Diamond like carbon films of 5-15 nm were deposited on copper gaskets which were sealed in 304-stainless steel flanges. The carbon films acted as a diffusion barrier during high temperature bakeout (550 °C at 1 x 10/sup -5/ Torr for up to 200 hours) which prevented carbon diffusion into the copper. (AIP)

43641 **Electron beam effects in the analysis of compound semiconductors and devices.** Kazmerski, L.L.; Burnham, N.A.; Swartzlander, A.B.; Nelson, A.J.; Asher, S.E. (Solar Energy Research Institute, Golden, Colorado 80401). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **5**: No. 5, 2814-2818(Sep 1987). Contract AC02-83CH10093.

The effects of electron beams on the analysis of $CuInSe_2$ surfaces are examined in this paper. Potential changes in the surface chemistry: including oxidation and desorption: under a range of incident probe conditions, are investigated for possible artifactual information generation. Emphasis is placed on the relationships between beam conditions and oxygen chemisorption and physisorption, since oxygen treatments of devices utilizing this semiconductor are critical to performance. Single crystals and polycrystalline thin films are analyzed and compared to establish the beam-induced phenomena.

43642 **Electronic structure of ZnS, ZnSe, ZnTe, and their pseudobinary alloys.** Bernard, J.E.; Zunger, A. (Solar Energy Research Institute, Golden, Colorado 80401). *Physical Review [Section] B: Condensed Matter;* **36**: No. 6, 3199-3228(15 Aug 1987). Contract AC02-77CH00178.

Using the all-electron mixed-basis approach to the density-functional formalism for crystals, we calculate from first principles the electronic structure of zinc-blende ZnS, ZnSe, and ZnTe as well as that of their ordered pseudobinary alloys Zn_2SSe, Zn_2SeTe, and Zn_2STe. For the latter we use as a model a CuAu I—like structure (space group P4-barm2), and analyze the observed optical bowing in terms of three contributions: (i) a volume deformation of the band structure due to the replacement of the lattice constants of the binary constituents by that of the alloy, (ii) a chemical-electronegativity contribution due to charge exchange in the alloy relative to its constituent binary subsystems, and (iii) a structural contribution due to the relaxation of the anion-cation bond lengths in the alloy. The total bowing effect [the sum of (i)—(iii) above] agrees well with observations, yet the present analysis suggests a physical mechanism for optical bowing which differs profoundly from that offered by the popular virtual-crystal approach. The maximum contribution of disorder to the optical bowing is calculated for ZnS/sub x/Te/sub 1-//sub x/ using a cluster-averaging method, resulting in a reduction in the bowing of the fundamental gap. We further discuss the band structures, x-ray scattering factors, charge distribution, and deformation potentials of the binary zinc chalcogenides and their ordered alloys.

43643 **Curcumin as a positive resist dye optimized for g- and h-line exposure.** Renschler, C.L.; Stiefeld, R.E.; Rodriguez, J.L. (Sandia National Labs., Albuquerque, NM 87185). *Journal of the Electrochemical Society;* **134**: No. 6, 1586-1587(Jun 1987).

It has now been firmly established, both theoretically and experimentally, that the addition of a non-bleachable absorber (or dye) to photoresist can reduce notching and other linewidth control variations associated with the patterning of reflective surfaces. Such variations are due to two separate, but closely related, effects. The first of these effects is reflection of light off scattering centers on the substrate at angles other than surface-normal.

43644 **Fundamental aspects of pulsed-laser irradiation of semiconductors.** Jellison, G.E. Jr.; Lowndes, D.H.; Wood, R.F. (Solid State Div., Oak Ridge National Lab., Oak Ridge, TN 37831). pp 24-34 of Excimer lasers and optics. Luk, T.S. Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1987). (CONF-8609127—). Contract AC05-84OR21400.

From SPIE symposium on optics and optoelectronics; Cambridge, MA, USA (14 Sep 1986).

Fundamental aspects of pulsed laser melting and solidification of crystalline silicon and germanium are reviewed. The discussion concentrates on time-resolved experiments performed with nanosecond pulsed lasers, although some picosecond and femtosecond experiments are also considered. The creation of amorphous material from crystalline material induced by ultrarapid melting and resolidification using either nanosecond or picosecond lasers is sur-

veyed and the inverse process of recrystallization of a-Si by explosive crystallization is described. Finally, melting model calculations, which have proven to give a very accurate description of the pulsed laser irradiation process, are discussed.

43645 **X-ray diffraction of CdTe epitaxial layers on GaAs substrates as a function of temperature.** Horning, R.D.; Staudenmann, J.L.; Bonse, U.; Arch, D.K.; Schmit, J.L. (Ames Lab.-USDOE and Dept. of Physics, Iowa State Univ., Ames, IA 50011). pp 129-134 of X-rays in materials analysis: Novel applications and recent developments. Rusch, T.W. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860880—). Contract W-7405-ENG-82.

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

A (0,0,l) epitaxial layer of CdTe on a (0,0,l) GaAs substrate has been studied as a function of temperature by x-ray diffraction. Lattice parameters and integrated intensities of Bragg reflections were measured between 10 K and 360 K using a wavelength of 0.7093 A (Mo Kα). The lattice parameters were measured parallel and perpendicular to the interface. The changes of the integrated intensities with temperature give information about the thermal vibrations. Average Debye temperatures for the substrate and epilayer are 232+-2 K and 142+-2 K, respectively. These data are compared with data from CdTe and GaAs single crystals in order to understand how strain is propagated and/or relieved in the composite system.

43646 **Surface structure analysis using Grazing Incidence X-ray Scattering.** Brennan, S. (Stanford Synchrotron Radiation Lab., Stanford Univ., Box 4349, Bin 69, Stanford, CA 94305). pp 124-128 of X-rays in materials analysis: Novel applications and recent developments. Rusch, T.W. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860880—).

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

A description of the Grazing Incidence X-ray Scattering technique is presented including examples of the wide variety of work being performed in the areas of ordered overlayer structure determination, phase transition studies of ordered overlayers and structural studies of thin amorphous films. Topics considered include structural chemical analysis, thin films, amorphous states, and crystal-phase transformations.

43647 **Near Edge X-ray Absorption Fine Structure Spectroscopy in materials analysis.** Carr, R. (Stanford Synchrotron Radiation Lab., Stanford Univ., Stanford, CA 94305). pp 38-44 of X-rays in materials analysis: Novel applications and recent developments. Rusch, T.W. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860880—).

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

Near Edge X-ray Absorption Fine Structure (NEXAFS) Spectroscopy is a recently developed tool which is used to determine angular orientation and bond lengths of small molecules which adsorbed onto surfaces. Polarized soft x-rays from a synchrotron radiation source cause electronic transitions from core levels into unfilled molecular orbitals near the vacuum level. Many small molecules have unfilled π and σ symmetry orbitals, and dipole selection rules cause these transitions to be highly polarization dependent. By rotating the sample with respect to the photon beam, one observes this polarization dependence, and from this the angular orientations of the chemical bonds are inferred.

43648 **Experimental studies of photon-surface interaction dynamics in the alkali halides.** Haglund, R.F. Jr.; Tolk, N.H. (Dept. of Physics and Astronomy, Vanderbilt Univ., Nashville, TN 37235). pp 9-18 of X-rays in materials analysis: Novel applications and recent developments. Rusch, T.W. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860880—).

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

The authors describe recent measurements which have provided insights into the electronic mechanisms through which energy carried into a material by photon irradiation is absorbed, localized and rechanneled to produce desorption, surface modification, erosion and damage. The specific object of these studies has been desorption induced by electronic transitions in alkali halide crystals, with particular emphasis on the dynamics of changes in the surface and near-surface regions. In the experiments, the irradiating ultraviolet photons are provided by a synchrotron storage ring, and the dynamical information about desorption products is obtained from optical measurements of the quantum states, yields and velocity distributions of neutral ground-state and excited-state atoms ejected from the surface of the irradiating material.

43649 **Measurement of x-ray dielectric constants with coherent transition radiation.** Moran, M.J.; Dahling, B.A.; Piestrup, M.A.; Berman, B.L.; Kephart, J.O. (Lawrence Livermore National Lab., Livermore, CA). pp 146-152 of X-rays in materials analysis: Novel applications and recent developments. Rusch, T.W. Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860880—). Contract W-7405-ENG-48.

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

The authors have developed a technique for measuring the energy-resolved angular distribution of longitudinally coherent transition radiation generated in multiple-foil targets. This paper demonstrates how data generated by these measurements can be used to determine the dielectric constants of materials in the soft x-ray spectral region.

40 CHEMISTRY

REFER ALSO TO CITATION(S) 44228

43650 **(ORNL—6385) Chemistry Division: Annual progress report for period ending March 31, 1987.** (Oak Ridge National Lab., TN (USA)). Aug 1987. Contract AC05-84OR21400. 148p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87013361.

This report is divided into the following sections: coal chemistry; aqueous chemistry at high temperatures and pressures; geochemistry of crustal processes to high temperatures and pressures; chemistry of advanced inorganic materials; structure and dynamics of advanced polymeric materials; chemistry of transuranium elements and compounds; separations chemistry; reactions and catalysis in molten salts; surface science related to heterogeneous catalysis; electron spectroscopy; chemistry related to nuclear waste disposal; computational modeling of security document printing; and special topics. (DLC)

43651 **(RISO-M—2629) Annual report 1986 chemistry department.** Funck, J.; Larsen, E.; Nielsen, O.J. (eds.). (Risoe National Lab., Roskilde (Denmark)). Mar 1987. 56p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87752409.

This report contains a brief survey of the main activities in the Chemistry Department. All articles and reports published and lectures given in 1986 are presented. The facilities and equipment are mentioned briefly. The activities are divided into the following groups: radioisotope chemistry, analytical- and organic chemistry, environmental chemistry, polymer chemistry, radical chemistral, mineral processing, and general.

43652 **(UCID—20622-85-11) Chemistry research resource: Progress report, November 1985.** (Lawrence Livermore National Lab., CA (USA)). Jan 1986. Contract W-7405-ENG-48. 178p. NTIS, PC A09. File Number DE87013475.

Summaries are given of research projects in the following fields: synthesis of new materials, development of analytical techniques, chemical kinetics and transport processes, cryogenic and other physical properties of hydrogen isotopes, artificial intelligence, characterization techniques, materials modeling analysis, me-

chanical properties of polymers, mechanical properties, phase transformations, surface modification and surface studies, and new materials development and properties. (DLC)

43653 **(UCID—20622-86-7) Chemistry research resource: Progress report, July 1986.** (Lawrence Livermore National Lab., CA (USA)). Aug 1986. Contract W-7405-ENG-48. 89p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87012976.

This report is divided into: synthesis of new materials, development of analytical techniques, chemical kinetics and transport process, artificial intelligence, techniques for characterizing materials, materials modeling analysis, mechanical properties of polymers, phase transformations in physical metallurgy, surface modification and surface studies, and new materials development and properties. (DLC)

4001 Analytical And Separations Chemistry

REFER ALSO TO CITATION(S) 42975, 42990, 43010, 43033, 43047, 43061, 43083, 43114, 43167, 43573, 43574, 43575, 43576, 43577, 43647, 43648, 43794, 43909, 44182, 44217

43654 **(DOE/ER/45098—23) [National consortium for x-ray topography on line X-19 at NSLA: Technical progress report, January 1, 1987-August 1, 1987].** (State Univ. of New York, Stony Brook (USA). Dept. of Materials Science and Engineering). 1987. Contract FG02-84ER45098. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013922.

Three projects are reported on: study of creep damage using microradiography, synchrotron x-ray probing of acoustic waves, and synchrotron x-ray topography studies of defects and strain fields in metal-semiconductor interfaced materials. (DLC)

43655 **(EPRI-EA—5197) Measurement of bioavailable mercury species in fresh water and sediments: Final report.** Robertson, D.E.; Sklarew, D.S.; Olsen, K.B.; Bloom, N.S.; Crecelius, E.A.; Apts, C.W. (Pacific Northwest Lab., Richland, WA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jun 1987. Contract AC06-76RL01830. 128p. NTIS, PC A07/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number DE87011022.

We developed and evaluated state-of-the-art sampling, preservation, and analytical methods for the measurement of environmentally important species of mercury, using highly sensitive cold vapor atomic absorption techniques with preconcentration by gold amalgamation for the measurement of total mercury and elemental mercury forms, and very sensitive and selective gas chromatography coupled to microwave plasma emission spectrometry for individual alkyl and aryl mercury species. Samples from the Yakima River estuary at Richland, Washington, and from Hyco Reservoir, a cooling pond for a coal-fired power plant, contained extremely low concentrations of all forms of mercury in both water and sediments. Lake Onondaga had elevated total mercury concentrations in the sediments ranging from 307 to 1740 ng/g, although methyl mercury sediment concentrations were less than 0.8 ng/g. At all study sites, the ionic, elemental, and methyl mercury forms in the waters accounted for only a small fraction of the total dissolved mercury. The majority of the dissolved mercury in the water is bound organically, presumably in the form of fulvic and humic mercury complexes. This study resulted in an improvement in sensitivity by about a factor of ten over previous published techniques. Although the techniques provide adequate sensitivity for measuring background environmental concentrations of total mercury, ionic mercury, total dissolved organic mercury, and total volatile mercury, the background concentrations of alkyl mercury (mainly methyl mercury) remain very near or below detection limits. The sensitivity is adequate for regulatory purposes, but is only marginal for methyl mercury biogeochemical studies in low-mercury aquatic environments.

43656 **(IS-T—1282) Improved chromatographic detection methods based on absorbance and ultrasonic measurements.** Skogerboe, K.J. (Ames Lab., IA (USA)). Aug 1987. Contract W-7405-ENG-82. 110p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87013599.

This dissertation describes three new chromatographic detection techniques which provide improved chromatographic selectivity, sensitivity, and detectability. The first chapter presents a basic introduction to chromatography and describes detection methods in gas and liquid chromatography. The project described in the second chapter is a laser-based absorbance probe utilizing fiber optic technology. The probe is applicable to microbore liquid chromatography, providing a submicroliter cell volume with a 3-mm pathlength. Linear response is made possible by minimizing stray light. This is accomplished first by reducing reflections through refractive index matching, and second, by using a unique optical delay line and high-frequency modulation, which enables background correction through phase-sensitive detection. Chapter 3 describes a new thermal lens spectrometer suitable for microbore liquid chromatography detection. A single laser is used and a single beam passes through the cell to simplify alignment. Baseline stability of 1×10^{-4} and lock-in detection are made possible by a reference beam and high-frequency modulation (150 kHz). Detectability (S/N = 3) is found to be 3 pg of benzopurpurin 4B at 90 mW excitation (514.5 nm). This corresponds to an absorbance LOD of 4×10^{-6} au in a 1-cm cell. In Chapter 4 a new detection method for gas chromatography is described. The response of the ultrasonic gas chromatographic detector is used to determine both the absolute weight and the molar concentration of an unknown analyte without a calibration curve. The method does not require that any physical properties of the analyte be known. A detectability of 1 pg of hexane was found.

43657 **(IS-T—1318) Rapid determination of magnesium and calcium in water and serum by ion chromatography.** Smith, D.L. (Ames Lab., IA (USA)). Aug 1987. Contract W-7405-ENG-82. 73p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87013601.

Single column ion chromatography was used to separate calcium and magnesium on poly(styrene-divinylbenzene) sulfonated to a capacity of 9 μeq/g. A 0.12 M $HClO_4$ eluent was used. The ions were complexed with Arsenazo I, at pH 10, in a post column reactor. The complexes were monitored spectrophotometrically at 590 nm. The separation of these ions is achieved in under three minutes. The method is rapid, reproducible, accurate and relatively free of interferences. A variety of water samples were analyzed and results agreed to within 10% with those obtained from an EDTA titration. Serum samples were analyzed for the total and ionized fractions of calcium and magnesium. For the total ion concentration, the serum was acidified, centrifuged and the liquid layer was injected into the chromatograph. The ionized forms of calcium and magnesium were separated, from the protein matrix, on a "mini" column filled with 0.07 g of XAD-4 resin sulfonated to a capacity of 2.8 meq/g. The ions were eluted from the "mini" 4 column with 4 M HCl, the mixture was buffered to pH 10 and injected into the chromatograph. A flow rate of 35 mL/min was required to push the serum sample through the "mini" column to prevent the equilibria of the bound fractions of calcium and magnesium from shifting.

43658 **(JAERI-M—86-198) Cooperative analysis of zirconium and zirconium alloys by fluoresent x-ray method.** Takashima, Kyoichiro (ed.). (Japan Atomic Energy Research Inst., Tokyo). Mar 1987. 137p. (In Japanese). NTIS (US Sales Only), PC A07/MF A01. File Number DE87753011.

The Second Sub-Committee on Zircaloy Analysis was organized in April, 1978, under the Committee on Analytical Chemistry of Nuclear Fuels and Reactor Materials, JAERI, for the renewal of zirconium and zirconium alloys certified reference materials (CRM's). The Sub-committee has decided certified values of major constituents (4 elements) and impurities (14 elements) of the renewed CRM's in July, 1983, based on the result obtained by cooperative analyses, during 1978 to 1983. The CRM's are issued by JAERI. In this report, outline on 1st to 9th cooperative analyses by fluorescent X-ray method is described. In these cooperative works, decision of provisional certified values for alloying elements in

JAERI-Z11 to -Z14, harmonization of the certified values with that of JAERI-Z1 to -Z3 and NBS SRM 1213 to 1215, homogeneity test of impurity elements and developments of new analytical method for hafnium were carried out with nine participating laboratories.

43659 **(LYCEN—8503) Study of niobium oxidation by photoelectron spectroscopy.** Durand, C. (Lyon-1 Univ., 69 - Villeurbanne (France). Inst. de Physique Nucleaire; Lyon-1 Univ., 69 (France)). 1985. 87p. (In French). NTIS (US Sales Only), PC A05/MF A01. File Number DE87752231.

The chemical composition of thin oxide layers, grown on clean niobium, in low oxygen pressure, was studied by a surface analysis method: X-ray Photoelectron Spectroscopy. The purpose of this study was to find the best conditions for the building of Nb/Nb oxide/Pb Josephson junctions, and particularly to minimise the interface thickness during the formation of the insulator film (Nb/sub 2/O/sub 5/) on the metal (Nb). This interface is essentially formed by the monoxide (NbO) and dioxide (NbO/sub 2/). Nb 3d XPS core level peak positions and area ratios (obtained by the signal decomposition) of the components of the total peak, were used to determine the presence of the different oxidation states II, IV and V, their relative abundance, oxide thicknesses and their depth distribution. All this information was extracted by a special numerical procedure.

43660 **(UCRL—94424) Application of knowledge based systems technology to triple quadrupole mass spectrometry (TQMS).** Brand, H.R.; Wong, C.M. (Lawrence Livermore National Lab., CA (USA)). 4 Apr 1986. Contract W-7405-ENG-48. 17p. (CONF-860848—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011565.

From National conference on artificial intelligence; Philadelphia, PA, USA (11 Aug 1986).

The complexity of chemical instrumentation is such that automation of certain instrument functions by conventional algorithmic means is either very difficult or completely unsuitable. This paper details work in progress on the application of knowledge based systems technology to the tuning of a complex analytical instrument, a triple quadrupole mass spectrometer (TQMS). The knowledge representation schemes and interface design between the expert system and the TQMS instrument are discussed. Preliminary results of optimizing the TQMS on chemical standards are presented.

43661 **(Y/DW—734) Analyses of carbon, silicon and iron in uranium by sputter-initiated resonance ionization spectrometry and secondary-ion mass spectrometry.** Cristy, S.S. (Oak Ridge Y-12 Plant, TN (USA)). 23 Jun 1987. Contract AC05-84OS21400. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014049.

Analyses of carbon, iron, and silicon in uranium, U-0.75Ti, and U-6Nb alloys by sputter-initiated resonance ionization (SIRIS) and by secondary ion mass spectrometry (SIMS) were compared to bulk analyses by the LECO process for carbon and by spark source mass spectrometry or ac arc emission spectrometry for silicon and iron. Poor correlation of both the SIRIS and SIMS analyses with the LECO data for carbon were attributed to the problem of analysis of second phase inclusions spread non-homogeneously through the major phase. The same problem was encountered for silicon and iron, but with less serious results for SIMS. Control of sample matrix or chemistry (oxidation state) appears to be more important for successful SIRIS analysis than originally thought. More work in this area will be required to make SIRIS a useful quantitative tool for uranium and uranium alloy analyses.

43662 **Electrothermal vaporization and laser-induced fluorescence for screening of polyaromatic hydrocarbons.** Kirsch, B.A.; Winefordner, J.D. (Univ. of Florida, Gainesville). *Analytical Chemistry;* **59**: No. 14, 1874-1879(15 Jul 1987).

While the graphite furnace has been used as a vaporization source for laser-excited atomic fluorescence, it has not been widely applied to the laser-induced fluorescence of molecular vapors. In this work, laser-induced fluorescence of molecular vapors produced by electrothermal vaporization was investigated. The capabilities and behavior of the laser-induced fluorescence of polyaromatic hydrocarbons (PAHs) produced in a graphite furnace were evaluated in terms of sensitivity and potential use as a fingerprinting technique for particulate matter and other environmental samples. A new sampling technique was developed which allowed the direct collection of samples within the graphite rods of the furnace system. The advantages and limitations of this technique as a routine screening technique will be discussed.

43663 **Analysis of oxygen on and in beryllium using 2 MeV helium ions.** Musket, R.G. (Lawrence Livermore National Lab., CA). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **24/25**: No. 2, 698-700(Apr 1987). (CONF-861114—). Contract W-7405-ENG-48.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Also published as report UCRL—94819; CONF-861114—4-12.

Analysis of oxygen on beryllium can be routinely performed using helium-ion backscattering (RBS). However, determination of the bulk oxygen concentration by this technique is limited to about 350 atomic parts per million (appm). We have performed simultaneous RBS and particle-induced X-ray emission (PIXE) measurements to improve the detection limit for bulk oxygen. The RBS measurements allowed determination of the surface oxygen before and after in situ sputter cleaning by argon ions in an ultra-high-vacuum system. PIXE measurements of specimens with surfaces maintained clean by sputtering permitted assessment of the concentration of oxygen in the bulk. For our geometry and detector sensitivities, 90% of the oxygen X-ray signal originated in the first 2.1 μm of the beryllium and a detection limit of 10 appm was found.

43664 **Use of a high repetition rate neutron generator for in vivo body composition measurements via neutron inelastic scattering.** Kehayias, J.J.; Ellis, K.J.; Cohn, S.H.; Weinlein, J.H. (Brookhaven National Lab., Upton; Sandia National Labs., Albuquerque, NM). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **24/25**: No. 2, 1006-1009(Apr 1987). (CONF-861114—). Contract AC02-76CH00016.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

A small D-T neutron generator with a high pulse rate is used for the in vivo measurement of body carbon, oxygen and hydrogen. The core of the neutron generator is a 13 cm-long Zetatron tube pulsed at a rate of 10 kHz delivering 10^3-10^4 neutrons per pulse. A target-current feedback system regulates the source of the accelerator to assure constant neutron output. Carbon is measured by detecting the 4.44 MeV γ-rays from inelastic scattering. The short half-life of the 4.44 MeV state of carbon requires detection of the γ-rays during the 10 μs neutron pulse. Generators with low pulsing rate were found inappropriate for carbon measurements because of their low duty-cycle (high neutron output during the pulse). In vivo measurements were performed with normal volunteers using a scanning bed facility for a dose less than 25 mrem. This technique offers medical as well as general bulk analysis applications.

43665 **Inorganic membrane technology.** McCaffrey, R.R.; McAtee, R.E.; Grey, A.E.; Allen, C.A.; Cummings, D.G.; Appelhans, A.D.; Wright, R.B.; Jolley, J.G. (EG & G Idaho, Inc., Idaho Falls). *Separation Science and Technology;* **22**: No. 2/3, 873-887(1987). (CONF-851011—). Contract AC07-76ID01570.

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

The objective of this program is to develop a variety of inorganic based high temperature separation membranes. Organic membranes are limited by temperature (<100°C) and chemical environments, and are unsuitable for high temperature applications. The higher temperature stabilities of inorganic materials make them ideal candidates for high temperature membrane applications. Polymers with inorganic backbone structures, such as the polyphosphazenes, are being examined for mid-temperature membrane separation applications (100°C - 350°C). Metallic and ceramic membrane materials are being examined for high temperature separation appli-

cations (350°C - 1000°C). The liquid and gas membrane test systems developed for this program are described. Preliminary results on the separation properties of poly[bis(2,2,2 trifluoroethoxy)phosphazene] membranes are reported for dilute aqueous methanol, ethanol, isopropanol, and phenol feedstreams.

43666 **Characteristics of transition radiation in the x-ray spectral region.** Moran, M.J. (Lawrence Livermore National Lab., L-43, P.O. Box 808, Livermore, CA 94550). pp 23-30 of X-rays in materials analysis: Novel applications and recent developments. Rusch, T.W. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860880—). Contract W-7405-ENG-48.

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

Measurements of soft x-ray production by transition radiation have been performed in a series of experiments at the Lawrence Livermore National Laboratory. The results have shown that transition radiation is an intense and predictable source of photons in the soft x-ray energy range. This paper gives a brief review of the general properties of the x-ray distributions generated by these sources.

4002 Inorganic, Organic And Physical Chemistry

REFER ALSO TO CITATION(S) 43102, 43103, 43133, 43167, 43389, 43390, 43391, 43392, 43393, 43394, 43395, 43397, 43398, 43399, 43440, 43646, 43659, 43858

43667 **(AD-A—180891/4/XAB) Metabolic products, mass spectral analyses, and synthesis of toxic trichothecenes. Final report, 15 April 1982-14 July 1985.** Mirocha, C.J. (Minnesota Univ., St. Paul (USA)). 31 Jul 1985. 37p. NTIS, PC A03/MF A01.

A mass spectral library of the trichothecenes was developed and delivered to USAMRIID. The structure of Fusarochromanone (causes bone deformation) was elucidated and the biological activity of this metabolite was determined. Metabolic studies of T-2 toxin were determined in chickens and the metabolites were identified. Similarly, a kinetic study of T-2 metabolism was done using a cow as the subject. De-epoxy-diacetoxyscirpenol was found in a Fusarium culture for the first time and de-epoxy-T2 tetraol was found in cow urine for the first time. Morphologic lesions of T-2 toxin in the cat were described.

43668 **(AD-A—180963/1/XAB) Mass-spectral investigations on toxins. 3. Accurate analysis and quantitation of macrocyclic trichothecenes in environmental, fungal, fermentation, and Brazilian plant samples by gas-chromatographic/negative ion chemical ionization-mass spectrometric techniques. Technical report, January 1983-October 1984.** Krishnamurthy, T.; Sarver, E.W.; Greene, S.L.; Jarvis, B.B. (Chemical Research, Development and Engineering Center, Aberdeen Proving Ground, MD (USA)). Mar 1987. 32p. (CRDEC-TR—87011). NTIS, PC A03/MF A01.

See also AD-A178 051.

A general, sensitive Gas Chromatographic Negative Ion Chemical Ionization-Mass Spectrometric method of analysis was developed for accurately detecting and measuring several polar, thermally labile,toxic macrocyclic trichothecenes. The procedure involves the conversion of the molecules into their corresponding alcohols (Verrucarols) by alkaline hydrolysis, followed by the derivatization of the hydrolysates with heptafluorobutyrylimidazole and analysis by the gas chromatographic/mass spectrometric techniques under negative ion chemical inoization conditions. Using this procedure, trace quantities (0.25-2 micrograms) of several macrocyclic trichothecenes with different verrucarol and ester moieties were analyzed successfully with good precision. The method developed was applicable for the accurate analysis of at least low part-per-billion levels of these macrocyclic trichothecenes in real-life samples such as fungal products, fermentation broths, and plant samples. This is the first report describing the well-developed, sensitive, and applicable method for detecting and measuring these compounds in true samples.

43669 **(AD-A—181142/1/XAB) Detoxification of acetylcholinesterase inhibitors. Final report, 1 June 1984-30 November 1986.** Wild, J.R.; O'Donovan, G.A.; Chang, T. (Texas A and M Univ., College Station (USA). Research Foundation). 19 Feb 1987. 1p. NTIS, PC A02/MF A01.

The research support by ARO contract 21288-LS entitled Detoxification of acetylcholinesterase inhibitors resulted in the cloning and partial sequence of two opd genes from Pseudomonas diminuta and Flavobacterium species. It has been possible to isolate the enzyme in association with a small membrane fraction and initiate an evaluation of the organophosphate hydrolase. Collaborative interactions with research scientists at the Chemical Defense Research Command have suggested that the Pseudomonas species is competent to degrade selected types of biological neurotoxins.

43670 **(DOE/ER/10346—6) Fundamental studies in isotope chemistry: Final report, 1 October 1968-31 January 1987.** Bigeleisen, J. (Rochester Univ., NY (USA); State Univ. of New York, Stony Brook (USA)). 1987. Contract AC02-79ER10346. 96p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87013704.

The research has concentrated in two general areas: (1) correlation of isotope chemistry with molecular structure and (2) condensed phase isotope effects.

43671 **(DOE/ER/13383—2) Photolytic processes for measurement of combustion heats of formation and reaction rates: Progress report.** Okabe, H.; Halpern, J.B. (Howard Univ., Washington, DC (USA). Dept. of Chemistry). 1986. Contract FG05-85ER13383. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014047.

The alkoxy radicals (RO) are important intermediates in combustion of hydrocarbons. Laser-excited fluorescence is being used to detect RO. RO is produced by pulsed 10-Hz photolysis of RONO at 355 nm. The reaction rates of i-C_3H_7O with NO, O_2, CO, CH_4, and H_2 were measured. The emission bands and lifetime of i-C_3H_7O were studied. Attempts made to measure the heat of formation of CH_3O radicals were not yet successful. (DLC)

43672 **(IS-T—1248) Studies on the mechanism of ethylene hydrogenation over iridium (111) single crystals.** Lloyd, J.T. (Ames Lab., IA (USA)). Aug 1987. Contract W-7405-ENG-82. 119p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87013611.

The kinetics of ethylene hydrogenation on iridium (111) single crystals were measured in the temperature range of 312K to 625K. The pressure of hydrogen was varied from 0.4 to 626 torr and the pressure of ethylene was varied from 0.08 to 588 torr to determine the kinetic order of each reactant at 473K. The hydrogen kinetic order was determined to be 1. The ethylene kinetic order varied from 1 at low pressures to 0 at higher pressures. The data were fit to a Langmuir Hinshelwood mechanism. The temperature dependence of ethylene hydrogenation yielded an activation energy of 12.5 kcal/mole between 312K and 400K. A maximum in the temperature versus rate plot is attributed to a change in the form of the adsorbed ethylene which is hydrogenated on the surface. Thermal desorption and Auger electron spectroscopies supported this argument by providing additional information on the nature of partially hydrogenated carbonaceous surface species on the surface after ethylene hydrogenation. The yield of side product, methane, was determined under the same conditions as the hydrogenation reaction. Methane was observed to originate from ethylene and not hydrogenolysis of the hydrogenation product, ethane. The quality of the data did not allow accurate determination of the orders for methane formation. The activation energy is 4.88 kcal/mole. 62 refs., 27 figs.

43673 **(LA-UR—87-1611) Gaining control over rare earth valence fluctuations.** Wohlleben, D. (Los Alamos National Lab., NM (USA)). 31 May 1987. Contract W-7405-ENG-36. 6p. (CONF-8705120—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010116.

From NATO advanced workshop on narrow band phenomena; Staverden, Netherlands (31 May 1987).

This paper briefly deals with the problem of narrow band materials. It addresses a new theoretical approach to the fluctuation

of valence electrons in rare earth elements. It is believed that the phenomena of interest arize from an instability of the partially filled d or f shell of certain atoms when they are put into a metallic host. The theoretical models which dominate the scene work with two local d or f states on one hand and a structureless sea of free conduction electrons on the other. This procedure ignores at least half of the essential physics; the other held is kept alive in the term valence fluctuation. Basically, what the prevalent models ignore is that, in all these systems, the entire atoms as the source of the anomalies are being dealt with, not just their f shells. In other words, there is important structure in the sea of conduction electrons.

43674 **(LBL—23667) Molecular beam studies of the unimolecular decomposition of substituted benzene compounds.** Brudzynski, R.J. Jr. (Lawrence Berkeley Lab., CA (USA)). Jun 1987. Contract AC03-76SF00098. 158p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87014113.

Toluene was observed to decompose via two pathways: loss of a hydrogen atom and loss of methyl radical. The mass spectra of the nascent benzyl and phenyl radicals were measured in order to obtain the branching ratio for the reactions. At the excitation energy of nearly 145 kcal/mole, C-H bond cleavage is about 8 times more likely than the other channel. A comparison of the derived center-of-mass translational energy distributions with the distributions calculated using RRKM theory showed good agreement for C-C bond cleavage. The experimental distribution for the dominant channel was wider than the calculated one. Chapter Two deals with the photolysis of 7-isopropyl-cycloheptatriene at 266 nm. Upon internal conversion and isomerization, highly excited isobutylbenzene and isopropyltoluene were formed. We observed methyl radical loss from isopropyltoluene and isopropyl radical loss from isobutylbenzene. A measurement was made of the rate constant for the overall process. Our value of 2 x 10^5/s, although quite reasonable, is in disagreement with bulk phase studies. The investigation described in Chapter Three involves the decomposition of an "exotic" species, the collision complex formed when an oxygen atom reacts with chlorobenzene. The signal level is probably indicative of a lower rate constant relative to the reaction of O(^{3}P) with benzene. Loss of a hydrogen atom from the collision complex was observed and its translational energy distribution is consistent with a small barrier in the exit channel. Evidence for another, rather energetic channel was obtained. It may correspond to CO elimination from the complex. Preliminary results for the reactive scattering of oxygen atoms with bromobenzene and iodobenzene are also mentioned.

43675 **(N—87-22048) Thermo-oxidatively stable condensation polyimides containing 1,1,1-triaryl-2,2,2-trifluoroethane dianhydride and diamine monomers.** Alston, W.B.; Gratz, R.F. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1987. 5p. (NASA-TM—89875; E—3551; NAS—1.15:89875; AVSCOM-TR—87-C-7). NTIS, PC A02/MF A01.

Nine new condensation polyimides containing the trifluorophenylethylidene linkage were synthesized by the amic acid route. Several other polyimides, including some with the hexafluoroisopropylidene linkage, were also prepared as controls. Amic acid solutions were characterized by determining their inherent viscosities prior to thermal conversion into polyimide films. Glass transition temperatures (T sug g), thermogravimetric analysis (TGA), and isothermal weight loss data were obtained for the films. The films were pulverized into molding powders which, in turn, were thermally processed under pressure into neat resin discs. The discs were also characterized by T sub gs and 316 C and 371 C isothermal weight losses. The film study identified two new polyimides with T sub gs greater that 371 C and two new polyimides with low rates of weight loss. The resin discs exhibited the same overall trends in T sub g and weight loss as the respective films, however the weight loss per unit surface area was always greater, presumably due to voids or to mechanical degradation induced during preparation of the molding powders.

43676 **(UCRL—96184) Excited state absorption of V^{2+} and Cr^{3+} ions in crystal hosts.** Payne, S.A.; Chase, L.L. (Lawrence Livermore National Lab., CA (USA)). 1987. Contract W-7405-ENG-48. 16p. (CONF-8708116—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013497.

From 6. international conference on dynamical processes in excited states of solids; Tsukuba, Japan (11 Aug 1987).

We have measured the excited state absorption spectra of $KMgF_3:V^{2+}$, $Na_3Ga_2Li_3F_{12}:Cr^{3+}$, and $BeAl_2O_4:Cr^{3+}$. The $^4T_2 \rightarrow {}^4T_1a$, ^4T_1b transitions were observed for the first two systems, while the ^2E, $^2T_1 \rightarrow {}^2T_2$ transitions were seen for $BeAl_2O_4:Cr^{3+}$. All excited state absorptions, except the $^4T_2 \rightarrow {}^4T_1a$ transition, can be understood on the basis of simple crystal field theory. The $^4T_2 \rightarrow {}^4T_1a$ transition is found to be profoundly modified by the Jahn-Teller effect, such that it is broader and at higher energy than otherwise expected. This excited state absorption is observed to overlap the emission spectrum of $KMgF_3:V^{2+}$, and thereby substantially reduce the effective stimulated emission cross-section.

43677 **(UCRL—96930) Theoretical approaches to chemical dynamics in highly compressed fluids.** Calef, D.F. (Lawrence Livermore National Lab., CA (USA)). 1 Jul 1987. Contract W-7405-ENG-48. 8p. (CONF-870753—21). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012242.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

Methods that have been developed in the chemical physics community over the previous decade are applied to problems involving the dynamic chemical behavior of fluids under highly compressed conditions. The methods require detailed structural information about the environment seen by the reacting molecules. These methods are briefly reviewed. Examples for both statically compressed and shock conditions are discussed.

43678 **Heteronuclear diatomic transition-metal cluster ions in the gas phase. Reactions of $CuFe^+$ with hydrocarbons.** Tews, E.C.; Freiser, B.S. (Purdue Univ., West Lafayette, IN). *Journal of the American Chemical Society;* **109**: No. 15, 4433-4439(22 Jul 1987). Contract AC02-80ER10689.

The reactions of $CuFe^+$ with a variety of hydrocarbons and oxygenated species were studied with Fourier transform mass spectrometry. $CuFe^+$ is unreactive with linear (C_1-C_6) and cyclic (C_3-C_6) alkanes. However, it does react with aliphatic alkenes which contain a linear C_4 unit, chiefly by dehydrogenation. The only aliphatic alkene in which C-C bond cleavage is observed is 2,3,3-trimethyl-1-butene, yielding methane elimination. The secondary reactions of the aliphatic alkenes generally yield more dehydrogenation than the primary reactions. Ion-molecule reactions, collision-induced dissociation, and photodissociation studies yield $D^0(Cu^+\text{-Fe}) = 53 +/- 7$ kcal/mol and $D^0(Fe^+\text{-Cu}) = 56 +/- 7$ kcal/mol. Finally, reaction between $CuFe^+$ and ethylene oxide yields both $CuFeCH_2^+$ and $CuFeO^+$, indicating $D^0(CuFe^+\text{-}CH_2) > 79$ kcal/mol and $D^0(CuFe^+\text{-O}) > 85$ kcal/mol, respectively.

43679 **Evidence for a bond homolysis pathway for O_2 release in the decomposition of the superoxochromium(III) ion CrO_2^{2+}.** Brynildson, M.E.; Bakac, A.; Espenson, J.H. (Ames Lab., IA). *Journal of the American Chemical Society;* **109**: No. 15, 4579-4583(22 Jul 1987). Contract W-7405-ENG-82.

The cation $(H_2O)_5CrO_2^{2+}$ has a considerable lifetime in aqueous solution in the absence of Cr^{2+}. One pathway for decomposition consists of bond homolysis, $CrO_2^{2+} \rightarrow Cr^{2+} + O_2$, with k = 2.5 x 10^{-4} s^{-1} at 25.0°C (ΔH/sup double dagger/ = 25.1 +/- 1.1 kcal mol^{-1}, ΔS/sub double dagger/ = 9.7 +/- 3.6 cal mol^{-1} K^{-1}). The resulting Cr^{2+} then reacts very rapidly with CrO_2^{2+}, with k = 8 x 10^8 M^{-1} s^{-1}, estimated by kinetic modeling of the effect of $[O_2]$. A second pathway, which yields $HCrO_4^-$, proceeds by a bimolecular reaction between two CrO_2^{2+} ions. It is characterized by a rate constant 6.0 +/- 0.9 M^{-1} s^{-1} at 25°C (ΔH/sup double dagger/ = 12.0 +/- 1.7 kcal mol^{-1}, ΔS/sub double dagger/ = -14 +/- 6 cal mol^{-1} K^{-1}). A structure of the activated complex for this pathway is proposed. The equilibrium constant for homolysis of CrO_2^{2+} is K/sub hom/ = 1.6 x 10^{-12} M and that calculated from the thermo-

dynamic data for heterolysis ($CrO_2^{2+} \rightleftharpoons Cr^{3+} + O_2^-$) is K/sub het/ = 3 x 10^{-8} M. The latter, although kinetically unimportant, is suitable for thermodynamic analysis. The Lewis basicity of O_2^- for Cr^{3+} is discussed on the basis of comparisons to cobalt(III)-ammine complexes, other $(H_2O)_5CrX^{2+}$ complexes, and acid ionization constants. The data do not require a description of CrO_2^{2+} as other than a superoxochromium(III)ion.

43680 **Transition-metal chromophore as a new, sensitive spectroscopic tag for proteins. Selective covalent labeling of histidine residues in cytochromes c with chloro(2,2':6',2"-terpyridine)platinum(II) chloride.** Ratilla, E.M.A.; Brothers, H.M. II; Kostic, N.M. (Ames Lab., IA). *Journal of the American Chemical Society;* **109**: No. 15, 4592-4599(22 Jul 1987). Contract W-7405-ENG-82.

Reactivity and selectivity of $Pt(trpy)Cl^+$ toward proteins are studied with cytochromes c from horse and tuna as examples. The new transition-metal reagent is specific for histidine residues at pH 5. The reaction, facile one-step displacement of the Cl^- ligand by imidazole, produces good yield. The binding sites, His 26 and His 33 in the horse protein and His 26 in the tuna protein, are identified by UV-vis spectrophotometry and by peptide-mapping experiments. Model complexes with imidazole, histidine, histidine derivatives, and histidine-containing peptides are prepared and characterized. The covalently attached $Pt(trpy)^{2+}$ labels allow easy separation of the protein derivatives by cation-exchange chromatography. The labels do not perturb the conformation and reduction potential of cytochrome c, as shown by UV-vis spectrophotometry, cyclic voltammetry, differential-pulse voltammetry, EPR spectroscopy, and ^1H NMR spectroscopy. The selectivity of $Pt(trpy)Cl^+$ is entirely opposite from that of $PtCl_4^{2-}$ although both of them are platinum(II)-chloro complexes. Owing to an interplay between the steric and electronic effects of the terpyridyl ligand, the new reagent is unreactive toward methionine (a thio ether) and cystine (a disulfide), which are otherwise highly nucleophilic ligands, but very reactive toward imidazole, which is otherwise a relatively weak ligand. Unusual and useful selectivity of preformed transition-metal complexes toward proteins evidently can be achieved by a judicious choice of ancillary ligands.

43681 **Synthetic, electrochemical, optical, and conductivity studies of coordination polymers of iron, ruthenium, and osmium octaethylporphyrin.** Collman, J.P.; McDevitt, J.T.; Leidner, C.R.; Yee, G.T.; Torrance, J.B.; Little, W.A. (Stanford Univ., CA). *Journal of the American Chemical Society;* **109**: No. 15, 4606-4614(22 Jul 1987).

A series of ligand-bridged metalloporphyrin polymers, [M(OEP)(L-L)]/sub n/ (M = Fe, Ru, Os; L-L = pyrazine, 4,4'-bipyridine, 1,4-diazabicyclo[2.2.2]octane), have been synthesized and characterized. When partially oxidized, these polymers are highly conductive. The conductivity of these polymers depends on the extent of doping, the nature of the central transition metal, and the bridging ligand. The doped polymers exhibit strong infrared absorptions due to mixed-valence transitions, the features of which correlate with the bulk conductivity. The infrared spectra of the doped [Os(OEP)(pyz)]/sub n/ samples reveal the presence of a coupling between an IR-silent vibrational mode of the bridging ligand and a mixed-valence transition, which suggests that the bridging ligand participates in the conduction process. Electrochemical studies of the polymers have been carried out with carbon cloth electrodes. These studies demonstrate that the doping reactions are metal-centered and corroborate the assertion that the porphyrin π-electrons are not involved in the conduction pathway. This feature contrasts with most of the previous work with porphyrinic conductors in which the conduction pathway is dominated by the macrocycle.

43682 **Formation, chemistry, and thermochemistry of primary amide complexes of Fe^+ and Co^+ in the gas phase.** Buckner, S.W.; Freiser, B.S. (Purdue Univ., West Lafayette, IN). *Journal of the American Chemical Society;* **109**: No. 15, 4715-4716(22 Jul 1987). Contract AC02-80ER10689.

Recently there has been renewed interest in the preparation and properties of transition-metal-amide complexes. Later transition-metal amides may have catalytic utility in the synthesis of amines and other nitrogen-containing organic compounds but to date very few have been reported. The instability of these complexes has been attributed to the unfavorable d reverse arrow p interaction for later transition metals. Because of this, the majority of the amide complexes reported have contained α-nitrogen groups such as SiR_3 which can withdraw $p\pi$ electron density from the nitrogen and thus stabilize the M-N bond. Primary amide complexes are extremely rare and with few exceptions have involved early transition metals. A recent gas-phase study provided evidence that $D^0(Co^+-NH_2)$ could be less than 19 kcal/mol. They report here on the formation of iron and cobalt primary amide complexes in the gas phase and on their chemistry and thermochemistry which, to the contrary, indicates relatively strong metal-amide bonding.

43683 **Preparation and structure of $[(Me_3CO)_3W$ identical with C-$Ru(CO)_2(Cp)]$, a heteronuclear, μ_2-carbide complex.** Latesky, S.L.; Selegue, J.P. (Univ. of Kentucky, Lexington). *Journal of the American Chemical Society;* **109**: No. 15, 4731-4733(22 Jul 1987).

Carbon monoxide dissociates to reactive carbide and oxide fragments on many catalytically active metal surfaces. Dissociation is believed to be the first step in the reductive hydrogenation of CO via the Fischer-Tropsch synthesis and related reactions. The remarkable reactivity of these surface carbides is probably due to the fact that they are highly exposed, with a low coordination number. Most organometallic carbide complexes contain carbon atoms surrounded by at least five metal atoms. However, $[Fe_4C(CO)_{12}]^{2-}$ and related tetranuclear carbide clusters studied by Bradley, Muetterties, and Shriver show high reactivity at the carbide ligand. The chemistry of $[Fe_3(CCO)(CO)_9]^{2-}$ suggests the intermediacy of a very reactive Fe_3C cluster. The sole fully characterized example of a two-coordinate metal carbide complex is $[Fe_2(\mu_2\text{-}C)(5,10,15,20\text{-}tetraphenylporphyrinate)_2]$. A dinuclear bicarbide complex, $[Ta_2(\mu_2\text{-}C_2)\{OSi(CMe_3)_3\}_6]$, has recently been reported by Wolczanski and co-workers. They report here the first heterodinuclear complex with a two-coordinate carbide ligand, $[(Me_3CO)_3W$ identical to C-$Ru(CO)_2(Cp)]$.

43684 **Solubilities of polynuclear aromatic hydrocarbons in mixtures of common organic solvents.** Coon, J.E.; Troth, M.; Mc Laughlin, E. (Dept. of Chemical Engineering, Louisiana State Univ., Baton Rouge, LA 70803). *Journal of Chemical and Engineering Data;* **32**: No. 2, 233-240(Apr 1987).

The solubilities of naphthalene, acenaphthene, fluorene, and phenanthrene have been determined experimentally in five binary mixtures and one quaternary mixture of four common organic solvents (benzene, cyclohexane, thiophene, and pyridine) from 25°C to the melting points of the solutes. The results have been correlated by using the classical equation for solid-liquid solubility and the experimental activity coefficients obtained have been compared to the values predicted by regular solution theory, extended regular solution theory, Wilson's equation, and UNIQUAC, after obtaining binary parameters from the solubility of each solute in the pure solvents.

43685 **Electrical conductance of liquid and supercritical water evaluated from 0°C and 0.1 MPa to high temperatures and pressures: Reduced-state relationships.** Marshall, W.L. (Chemistry Div., Oak Ridge National Lab., Oak Ridge, TN 37831). *Journal of Chemical and Engineering Data;* **32**: No. 2, 221-231(Apr 1987). Contract AC05-84OR21400.

The electrical conductance of liquid and supercritical water to high temperatures and pressures is represented by an equation that incorporates some earlier observed trends and a newly discovered reduced-state relationship presented here. Calculations with the equation are believed to describe within +-1 to +-5% the specific conductance of liquid water at temperatures from 0 to 374°C and at pressures from saturated vapor pressure to 1000 MPa (10 kbar). For supercritical water at fluid densities from about 0.3 to 1 g cm/sup -3/ and at temperatures from 374 to 1000°C, the uncertainties probably will increase from 5% to perhaps 15% at the highest temperatures and pressures.

43686 **Viscosity of the eutectic Li/sub 2/CO/sub 3/-Na/sub 2/CO/sub 3/-K/sub 2/CO/sub 3/ melt.** Ejima, T.; Sato, Y.; Yamamura, T.; Tamai, K.; Hasebe, M.; Bohn, M.S.; Janz, G.J. (Dept. of Metallurgy, Faculty of Engineering, Tohoku Univ., Sendai 980). *Journal of Chemical and Engineering Data;* **32**: No. 2, 180-182(Apr 1987).

The viscosity of the molten eutectic mixture of Li/sub 2/CO/sub 3/-Na/sub 2/CO/sub 3/-K/sub 2/CO/sub 3/(reagent grade) has been measured to 900°C by means of the oscillating crucible technique used for measurements in the absolute mode. The viscosity can be expressed by eta (mPa.s) = 0.1012 exp(33400/RT), where R equals 8.3143 J K/sup -1/ mol/sup -1/, and the accuracy limits are better than +-3%. The present results differ markedly from previously published results, and model calculations show that the differences can be understood, in large part, if the presence of a "voids" effect had escaped detection in the earlier work.

43687 **Vapor-liquid equilibria for the binary systems of benzene/toluene, diphenylmethane/toluene, m-cresol/1,2,3,4-tetrahydronaphthalene, and quinoline/benzene.** Klara, S.M.; Mohamed, R.S.; Dempsey, D.M.; Holder, G.D. (Dept. of Chemical and Petroleum Engineering, Univ. of Pittsburgh, Pittsburgh, PA 15213). *Journal of Chemical and Engineering Data;* **32**: No. 2, 143-147(Apr 1987).

Vapor-liquid equilibrium (VLE) data for the binary systems of benzene/toluene, diphenylmethane/toluene, m-cresol/1,2,3,4-tetrahydronaphthalene, and benzene/quinoline were measured at low to moderate pressures (0-1733 kPa) by using a static equilibrium cell. The data were isothermally correlated by using the Peng-Robinson equation of state to describe both vapor and liquid phases. The data were also correlated by using the Peng-Robinson equation of state to describe the vapor phase and the universal quasi-chemical (UNIQUAC) excess Gibbs free energy expression for the liquid phase.

43688 **The impact of the chemical constituents of hydrotreater feed on catalyst activity.** Stohl, F.V.; Stephens, H.P. (Sandia National Labs., Albuquerque, NM 87185). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **31**: No. 4, 251-256(Sep 1986). (CONF-860911—). Contract AC04-76DP00789.

From 192. American Chemical Society national meeting; Anaheim, CA, USA (7 Sep 1986).

In this paper the authors report the impacts on catalyst activity of four different chemical classes of compounds found in hydrotreater feeds. These chemical classes included the aliphatic hydrocarbons, neutral polycyclic aromatic compounds (PAC), nitrogen polycyclic aromatic compounds (N-PAC) and hydroxy polycyclic aromatic hydrocarbons (HPAH). Separation of a light hydrotreater process stream into four chemical classes has shown that about half of the stream is composed of aliphatic hydrocarbons. There are also small amounts of N-PAC and HPAH fractions. Hydrotreating each of these four fractions and the whole process stream with catalyst has shown that all four fractions cause deactivation. The greatest deactivation is due to the N-PAC fraction, although the HPAH fraction also yields greater deactivation than the whole process stream. The deactivation is caused primarily by active site poisoning, with a lesser amount due to a decrease in effective diffusivity.

4004 Electrochemistry

REFER ALSO TO CITATION(S) 43379, 43380, 43387, 43389, 43390, 43391, 43392, 43393, 43394, 43395, 43396, 43398, 43399, 43609, 43681

43689 **(CONF-8709116—2) Enhanced ionic conductivity in composite electrolytes.** Dudney, N.J. (Oak Ridge National Lab., TN (USA)). Jul 1987. Contract AC05-84OR21400. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013543.

From 6. international conference on solid state ionics; Garmisch-Partenkirchen, F.R. Germany (6 Sep 1987).

Calculations show that formation of a space-charge layer around the alumina particles in composite electrolytes, particularly LiI or β-AgI composites, is unlikely to give a large enhanced ionic conductivity. Conductivity studies of AgCl-alumina fiber composites demonstrate that AgCl grain boundaries or dislocations are necessary to form the high conductivity paths. Plastic deformation of the AgCl matrix greatly enhances the ionic conductivity of the composite. The role of the alumina fibers or particles is to limit the grain size upon primary recrystallization of the AgCl matrix.

43690 **(DOE/ET/26829—1) [Electrochemistry graduate fellowships: Final report].** (Electrochemical Society, Princeton, NJ (USA)). 20 Mar 1987. Contract FG02-80ET26829. 11p. NTIS, PC A02. File Number DE87013076.

The five papers, in fields relating to energy research or of interest to the Electrochemical Society, are processed separately for the data base. (DLC)

43691 **(LBL—23596) Microscale resolution of interfacial mass-transfer rates in electrode processes.** Whitney, G.M.; Tobias, C.W. (Lawrence Berkeley Lab., CA (USA)). Jun 1987. Contract AC03-76SF00098. 314p. NTIS, PC A14/MF A01; 1; GPO Dep. File Number DE87014086.

Results of four interrelated studies concerning the nature of electrolytic gas evolution are reported: (1) configurations of axisymmetric bubbles formed on curved surfaces are evaluated; (2) mass-transfer enhancement by a stream of bubbles rising near a mass-transfer surface is resolved spatially and temporally using a micro-mosaic electrode; (3) the onset of buoyancy-induced convection is investigated for a case in which the density profile develops in a semi-infinite fluid, due to a step change in surface concentration at a rigid, conducting boundary; (4) observations of galvanostatic growth and disengagement of hydrogen bubbles at a 127-μm-diameter micro-electrode embedded in a large, coplanar, horizontal electrode in 1.0-M sulfuric acid are reported.

43692 **Reduced state relationship for limiting electrical conductances of aqueous ions over wide ranges of temperature and pressure.** Marshall, W.L. (Chemistry Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Journal of Chemical Physics;* **87**: No. 6, 3639-3643(15 Sep 1987). Contract AC05-84OR21400.

A reduced state relationship for limiting electrical conductances of aqueous ions to high temperatures and pressures is presented in which ionic conductance is a simple function of solvent density. Walden's rule is not observed. Specific parameters for 13 ions are included that can be used to calculate ionic conductances by the relationship. From these values, limiting equivalent conductances of many single and mixed aqueous electrolyte systems may be obtained over temperature—pressure ranges of 0—800°C and up to 400 MPa (4000 bar), with reasonable estimates to 1000°C and 1000 MPa.

43693 **Oxygen reduction kinetics on a platinum RDE coated with a recast Nafion film.** Gottesfeld, S.; Raistrick, I.D.; Srinivasan, S. (Electronics Div., Los Alamos National Lab., Los Alamos, NM 87545). *Journal of the Electrochemical Society;* **134**: No. 6, 1455-1461(Jun 1987).

Measurements of currents of the oxygen reduction reaction (ORR) at a Pt RDE coated with a recast Nafion film yield the permeability of O/sub 2/ through such films. Combined with results from linear potential scanning experiments on similar electrodes, these measurements also allow the separate evaluation of the concentration of O/sub 2/ and its diffusion coefficient in such films. Similar recast Nafion films have been used successfully to promote protonic access to catalyst sites in fuel cells. Accordingly, the maximum film thickness which would allow adequate oxygen flux through such a layer is evaluated. Measurements in 85% H/sub 3/PO/sub 4/ at room temperature show that a very significant enrichment of O/sub 2/ (e.g., by a factor of 20) in a region close to the electrode can be achieved by coating the electrode with a recast Nafion film. This result is expected from the high solubility of O/sub 2/ in Nafion.

4005 Photochemistry

REFER ALSO TO CITATION(S) 43166, 43387, 43674, 43678, 43923

43694 **Effect of cholesterol on the solubilization site and the photoionization efficiency of chlorophyll a in dipalmitoylphosphatidylcholine vesicle solutions as studied by electron spin resonance and optical absorption spectroscopies.** Hiromitsu, I.; Kevan, L. (Univ. of Houston, Texas). *Journal of the American Chemical Society;* **109**: No. 15, 4501-4507(22 Jul 1987).

Electron spin resonance (ESR) and optical absorption studies are carried out to investigate the solubilization site and the photoionization efficiency of chlorophyll a (Chla) in DL-α-dipalmitoylphosphatidylcholine (DPPC) vesicles due to varying concentration of cholesterol. With an increase in the cholesterol concentration, the optical absorption intensity of Chla decreases in liquid vesicle solutions, indicating that the local light intensity inside the vesicle decreases. Photoionization efficiencies of Chla in frozen vesicle solutions with and without potassium ferricyanide, a lipophobic electron scavenger, decrease with the cholesterol addition, while no effect of added cholesterol is seen in electron-transfer efficiency from photoexcited Chla to p-benzoquinone, a lipophilic electron scavenger, in liquid vesicle solution. Paramagnetic dipolar interaction between photoproduced Chla cation and added ferricyanide ion becomes weaker with cholesterol addition in frozen vesicle solutions. It is concluded that both Chla and p-benzoquinone move deeper into the vesicle bilayer when cholesterol is added because of an increase in the internal fluidity or alkyl chain straightening of the bilayer.

43695 **Laser-jet delayed trapping: electron-transfer trapping of the photoenol from 2-methylbenzophenone.** Wilson, R.M.; Hannemann, K.; Heineman, W.R.; Kirchhoff, J.R. (Univ. of Cincinnati, OH). *Journal of the American Chemical Society;* **109**: No. 15, 4743-4745(22 Jul 1987). Contract FG02-86ER60487.

During the course of the development of the argon ion laser-jet technique for the study of high-intensity photochemistry, it became apparent that the laser jet provided a unique opportunity for the trapping of relatively long-lived photochemical intermediates. Thus, the jet solution containing the photochemical substrate could be passed through the focal region of the laser just before it was injected into a fountain of a solution containing the photochemical substrate could be passed through the focal region of the laser just before it was injected into a fountain of a solution containing the trapping agent. Through the partitioning of the photochemical and trapping steps in this way, it should be possible to employ unusual trapping agents that would quench the formation of the photointermediate or would themselves initiate undesired photochemistry, if they were present during the irradiation phase. One can estimate on the basis of the parameters of the current jet apparatus that photochemical intermediates with lifetimes of about 10^{-2} s or greater should be amenable to trapping by this delayed trapping technique. The E-photoenol derived from 2-methylbenzophenone would seem to be an ideal candidate for this type of trapping experiment since it is known to have a lifetime of several seconds. In this report, they describe the first application of this laser-jet delayed trapping technique and the unusual photoenol chemistry observed during the course of this study.

43696 **Photosensitized production of singlet molecular oxygen (^1m/sub g/O_2) in a solid organic polymer glass: a direct time-resolved study.** Ogilby, P.R.; Iu, K.; Clough, R.L. (Univ. of New Mexico, Albuquerque). *Journal of the American Chemical Society;* **109**: No. 15, 4746-4747(22 Jul 1987). Contract AC04-76DP00789.

The photosensitized production of singlet molecular oxygen ($^1\Delta$/sub g/O_2) has long been a subject of scientific study. Recently, direct evidence for the presence of $^1\Delta$/sub g/O_2 in thin (10-30 μm) polymer films was obtained by Byteva et al. who detected $^1\Delta$/sub g/O_2 phosphorescence ($^3\Sigma$/sub g/$^-O_2$ reverse arrow $^1\Delta$/sub g/O_2: 1270 nm) in a steady-state photosensitized experiment. In a time-resolved study, $^1\Delta$/sub g/O_2 has also been observed in a heterogeneous ionomer system (Nafion powders) in which the $^1\Delta$/sub g/O_2 sensitizer was apparently located at the surface of solvent filled or dessicated cavities. They now report that $^1\Delta$/sub g/O_2 phosphorescence can be detected in a time-resolved photosensitized experiment from a homogeneous, solid polymethylmethacrylate (PMMA) glass. As in the solution phase, they expect this technique will become an indispensable tool in studies of $^1\Delta$/sub g/O_2 photophysics and photochemistry. In particular, the role of $^1\Delta$/sub g/O_2 in the photooxidation and photodegradation of solid polymers has been a focus of debate. Since they directly monitor molecular oxygen, this experimental approach also provides a unique method to accurately quantify oxygen diffusion in a polymer.

4006 Radiation Chemistry

REFER ALSO TO CITATION(S) 43120

43697 **(JAERI-M—87-046) Annual report of the Osaka Laboratory for Radiation Chemistry, Japan Atomic Energy Research Institute (No. 19). April 1, 1985-March 31, 1986.** (Japan Atomic Energy Research Inst., Tokyo). Mar 1987. 63p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87752986.

This report describes research activities of Osaka Laboratory for Radiation Chemistry, JAERI during one year period from April 1, 1985 through March 31, 1986. The latest report, for 1984, is JAERI-M 86-051. Detailed descriptions of the activities are presented in the following subjects: studies on surface phenomena under electron and ion irradiations; polymerization under the irradiation of electron beams; modification of polymers, degradation, cross-linking, and grafting.

43698 (PPA/SS—10, pp 1-8) **Chemistry of UV and EB radiation curing.** Garnett, J.L. (New South Wales Univ., Kensington, Australia. School of Chemistry). Feb 1987. NTIS (US Sales Only), PC A07/MF A01. File Number DE87780152. (CONF-861285—).

From National executive management seminar on industrial radiation curing technology; Kuala Lumpur, Malaysia (8 Dec 1986).

The application of photopolymerisation (UV) and electron beam (EB) technologies in radiation rapid cure (RRC) processing is discussed. The chemistry associated with such reactions and the mechanisms of the processes are treated. The occurrence of concurrent grafting to substrate with radiation curing of film is shown to be an advantage in enhancing the properties of certain finished products. The parameters influencing the optimum grafting yield in such RRC processes are discussed. In many applications, the chemistry of the process combined with the machine, expecially for EB, is shown a so-called "turn-key" operation. 20 refs.

43699 (PPA/SS—10, pp 31-44) **Present state of EBC technology in Japan.** Oka, Joji. (Nippon Steel Corp., Tokyo). Feb 1987. NTIS (US Sales Only), PC A07/MF A01. File Number DE87780152. (CONF-861285—).

From National executive management seminar on industrial radiation curing technology; Kuala Lumpur, Malaysia (8 Dec 1986).

The present state of EBC resins and apparatus in Japan are described. Examples of their application to commercial production are introduced. (A.J.).

43700 (PPA/SS—10, pp 89-131) **Electron beam curing-equipment, applications, economy.** Lauppi, U.V. (Ateliers des Charmilles S.A., Geneva, Switzerland). Feb 1987. NTIS (US Sales Only), PC A07/MF A01. File Number DE87780152. (CONF-861285—).

From National executive management seminar on industrial radiation curing technology; Kuala Lumpur, Malaysia (8 Dec 1986).

This paper contains an overview on equipment, process parameters, applications, economy of electron beam processing and safety aspects. (A.J.). 11 refs.

43701 (PPA/SS—10) National executive management seminar on industrial radiation curing technology, Kuala Lumpur, 8-10th December 1986. Proceedings. (Unit Tenaga Nuklear, Bangi, Selangor (Malaysia)). Feb 1987. vp. (CONF-861285—). NTIS (US Sales Only), PC A07/MF A01. File Number DE87780152.

From National executive management seminar on industrial radiation curing technology; Kuala Lumpur, Malaysia (8 Dec 1986).

Separate abstracts were prepared for individual records.

4007 Radiochemistry And Nuclear Chemistry

REFER ALSO TO CITATION(S) 43052, 44514

43702 (CONF-870822—6) Gadolinium-153 production at the Oak Ridge National Laboratory. Ramey, D.W. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013678.

From American Institute of Chemical Engineers summer national meeting; Minneapolis, MN, USA (16 Aug 1987).

Gadolinium-153 production at the Oak Ridge National Laboratory (ORNL) involves the neutron irradiation of natural europium oxide (47.8% ^{151}Eu, 52.2% ^{153}Eu). This target material undergoes a series of neutron captures and radioactive decays to produce the desired ^{153}Gd product. Several undesirable europium isotopes (^{152}Eu, ^{154}Eu, and ^{156}Eu) are also produced during this irradiation process. Recent technical advances and other improvements in the radiochemical processing of this isotope have allowed ORNL to increase production by more than sevenfold. A newly developed electrochemical process has allowed the separation of the bulk of undesirable europium isotopes and has also effected a more efficient use of high-pressure ion exchange to achieve a final product radiochemical purity >99.999%. Specific activities >60 Ci/g of gadolinium oxide and product specific yields >2.9 Ci/g of irradiated europium oxide have been produced. Use of unique glove box manipulators and special equipment designed at ORNL have allowed final source fabrication to keep pace with the increased production rate while minimizing the radiation exposure to operating personnel. 5 refs., 4 figs., 4 tabs.

43703 (DOE/NBM—7013421) The formation of Pu(IV)-colloid by the alpha-reduction of Pu(V) or Pu(VI) in aqueous solutions. Newton, T.W.; Hobart, D.E.; Palmer, P.D. (Los Alamos National Lab., NM (USA)). [1987]. Contract W-7405-ENG-36. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013421.

The effects of alpha-particle self-irradiation have been investigated in solutions of ^{239}Pu in the pH range from 1.3 to > 2.2. The initial solutions contained Pu(VI), Pu(V), colloidal Pu(IV) or various mixtures of these. Composition versus time was determined for periods up to 618 days. Colloidal Pu(IV) formed slowly in mixtures with initial average oxidation states greater than about 4.5. Colloidal Pu(IV) reacts slowly to give mixtures of Pu(V) and Pu(VI). The two most important reactions in the system appear to be: the disproportionation of Pu(V) to give Pu(VI) and colloidal Pu(IV), and the alpha-particle induced reduction of Pu(VI) to give Pu(V). Steady-states were reached very slowly and required at least 400 days for most of the mixtures. No evidence was found for equilibrium in the disproportionation reaction. 20 refs., 4 figs., 3 tabs.

4008 Combustion, Pyrolysis, And High-temperature Chemistry

REFER ALSO TO CITATION(S) 43671, 43767, 43768, 43981

43704 (DOE/ER/02944—12) The direct determination of atom and radical concentrations in thermal reactions of hydrocarbons and other gases: Final technical report, [June 1, 1976 to December 31, 1987]. Skinner, G.B.; Rao, V.S.; Wood, D.R. (Wright State Univ., Dayton, OH (USA)). Jul 1987. Contract AC02-76ER02944. 20p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87013994.

The method of atomic resonance absorption spectroscopy has been used to determine concentrations of H, D, and O atoms in shock-heated mixtures of various gases in argon. The analytical process was first calibrated, and then pyrolysis of methane, ethane, propane, benzene, toluene, ethylbenzene, 2,2-dimethylpropane, propene, 1,3-butadiene, and the vinyl radical were studied, with several related studies to clarify specific points. Oxidation of hydrogen, ethane and propane was studied by measuring all three types of atoms. Results were interpreted in terms of rate constants for elementary reactions, and the effects of energy transfer on unimolecular reactions were considered.

43705 (N—87-22020) Oxidation degradation of aromatic compounds. Final report, 1 September 1982-30 August 1985. Brezinsky, K.; Glassman, I. (Princeton Univ., NJ (USA)). May 1987. 46p. (NASA-CR—180588; NAS—1.26:180588). NTIS, PC A03/MF A01.

A series of experiments were conducted which focused on understanding the role that the O atom addition to aromatic rings plays in the oxidation of benzene and toluene. Flow reactor studies of the oxidation of toluene gave an indication of the amount of O atoms available during an oxidation and the degree to which the O atom adds to the ring. Flow reactor studies of the oxidation of toluene and benzene to which NO_2 was added, have shown that NO_2 appears to suppress the formation of O atoms and consequently reduce the amount of phenols and cresols formed by O atom addition. A high temperature pyrolysis study of phenol has confirmed that the major decomposition products are carbon monoxide and cyclopentadiene. A preliminary value for the overall decomposition rate constant was also obtained.

43706 (N—87-22028) Catalytic combustion for gas turbine combustors: reaction characteristics of monolithic Pd and Pt/Pd catalysts at 1 Atm. Hayashi, S.; Yamada, H.; Koshiba, M. (National Aerospace Lab., Chofu, Tokyo (Japan)). 1986. 32p. (NAL-TR—916). NTIS, PC A03/MF A01.

Studies were conducted to determine the reaction characteristics of monolithic palladium and platinum/palladium catalysts for perfectly premixed mixtures of propane/air and methane/air. The reactor is composed of five 2.5-cm-long Pd catalyst elements or four 3.8-cm-long Pt/Pd catalyst elements. Gas sampling is done between the catalysts to determine the combustion efficiency (conversion) and the levels of nitrogen oxides emissions for inlet mixture temperatures from 350 to 650 C. The maximum reactor outlet gas temperature is limited to circa 1100 C. Propane/air mixtures initiate reaction at lower temperatures than methane/air mixtures, and result in higher combustion efficiencies. The Pd catalysts are found to be more active than the Pt/Pd catalysts. The combustion efficiency data obtained at different reference velocities reveal that combustion efficiency can be correlated to the residence time. The conditions for 99% combustion efficiency are given as a function of inlet mixture temperatures, equivalence ratio, and reference velocity. Nitrogen oxides emissions are less than 1 ppm for all test conditions. Preliminary results of pressure loss measurements are described.

43707 (N—87-22806) Evaluation of metallized propellants based on vehicle performance. Zurawski, R.L.; Green, J.M. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1987. 27p. (CONF-8706157—4; NASA-TM—100104; E—3639; NAS—1.15:100104; AIAA—87-1773). NTIS, PC A03/MF A01.

From 23. AIAA/SAE/ASME/ASEE joint propulsion conference; San Diego, CA, USA (29 Jun 1987).

An analytical study was conducted to determine the improvements in vehicle performance possible by burning metals with conventional liquid bipropellants. These metallized propellants theoretically offer higher specific impulse, increased propellant density and improved vehicle performance compared with conventional liquid bipropellants. Metals considered were beryllium, lithium, aluminum and iron. Liquid bipropellants were H_2/O_2, N_2H_4/N_2O_4, RP-1/O_2 and H_2/F_2. A mission with a delta V = 4267.2 m/sec (14,000 ft/sec) and vehicle with propellant volume fixed at 56.63 cu m (2000 cu ft) and dry mass fixed at 2761.6 kg (6000 lb) was used, roughly representing the transfer of a chemically propelled upper-stage vehicle from a low-Earth orbit to a geosynchronous orbit.

The results of thermochemical calculations and mission analysis calculations for bipropellants metallized with beryllium, lithium, aluminum and iron are presented. Technology issues pertinent to metallized propellants are discussed.

43708 **Ignition by excimer laser photolysis of ozone.** Lucas, D.; Dunn-Rankin, D.; Hom, K.; Brown, N.J. (Applied Science Div., Lawrence Berkeley Lab., Univ. of California, Berkeley, CA 94720). *Combustion and Flame;* **69**: No. 2, 171-184(Aug 1987). Contract AC03-76SF00098.

The authors have ignited mixtures of hydrogen, oxygen, and ozone in closed cells with 248 nm radiation from a KrF excimer laser. Ozone, the only significant absorber in this system, absorbs a single photon and produces oxygen atoms which initiate combustion. A discretized, time-dependent Beer's law model is used to demonstrate that the radical concentration immediately after photolysis is a function of laser power, ozone concentration, focal length, and separation between the lens and reactions cell. Spark schlieren photographs are used to visualize the ignition events and identify the ignition sites. The effects of equivalence ratio, pressure, and the initial gas temperature on the minimum ozone concentration needed to produce ignition are presented, and only the initial temperature has a significant effect.

43709 **(N—87-22014) Pyrolysis of toluene and ethyl benzene.** Sokolovskaya, V.G.; Samgin, V.F.; Kalinenko, R.A.; Nametkin, N.S. Translated from *Neftekhimiya ;* **21**: No. 4, 544-551(May 1987). 15p. (NASA-TT—20012; NAS—1.77:20012). NTIS, PC A02/MF A01.

The pyrolysis of toluene at 850 to 950 C gave mainly H_2, CH_4, and benzene; PhEt at 650 to 750 C gave mainly H_2, CH_4, styrene, benzene, and toluene. The rate constants for PhEt pyrolysis were 1000 times higher than those for toluene pyrolysis; the chain initiation rate constants differed by the same factor. The activation energy differences were 46 kJ/mole for the total reaction and 54 kJ/mole for chain initiation. The chain length was evaluated for the PhEt case (10 + or - 2).

43710 **Laser-induced fluorescence measurement of combustion chemistry intermediates.** Crosley, D.R. (SRI International, Molecular Physics Dept., Menlo Park, CA). *High Temperature Materials and Processes;* **7**: No. 1, 41-54(1986).

Laser-induced fluorescence (LIF) can measure the trace (often free radical) species encountered as intermediates in combustion chemistry; OH, CS, NH, NS, and NCO are typical of the species detected in flames by LIF. Attention is given to illustrative experiments designed to accumulate a quantitative data base for LIF detection in low pressure flow systems and flames, as well as to flame measurements conducted with a view to the detection of new chemical intermediaries that may deepen insight into the chemistry of combustion. 20 references.

42 ENGINEERING

REFER ALSO TO CITATION(S) 44228

43711 **(LA-UR—87-2124) Performance of the LAGUNA pulsed power system.** Goforth, J.H.; Caird, R.S.; Fowler, C.M.; Greene, A.E.; Kruse, H.W.; Lindemuth, I.R.; Oona, H.; Reinovsky, R.E. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 9p. (CONF-870656—33). NTIS, PC A03. File Number DE87011747.

From 6. Institute of Electrical and Electronic Engineers pulsed power conference; Arlington, VA, USA (29 Jun 1987).

The goal of the LAGUNA experimental series of the Los Alamos National Laboratory TRAILMASTER program is to accelerate an annular aluminum plasma z-pinch to greater than one hundred kilojoules of implosion kinetic energy. To accomplish this, an electrical pulse >5.5 MA must be delivered to a 20 nH load in ~1 μs. The pulsed power system for these experiments consists of a capacitor bank for initial energy storage, a helical explosive-driven magnetic-flux compression generator for the prime power supply and opening and closing switches for power conditioning. While we have not yet achieved our design goal of 15 MA delivered to the inductive store of the system, all major components have functioned successfully at the 10 MA level. Significant successes and some difficulties experienced in these experiments are described.

43712 **(UCRL—96076) Interpreting signals with an assumption-based truth maintenance system.** Johnson, R.R.; Canales, T.W.; Lager, D.L.; Mason, C.L.; Searfus, R.M. (Lawrence Livermore National Lab., CA (USA)). Feb 1987. Contract W-7405-ENG-48. 7p. (CONF-870584—10). NTIS, PC A02. File Number DE87007322.

From Technical symposium southeast on optics, electro-optics and sensors; Orlando, FL, USA (17 May 1987).

This paper presents an expert system that interprets seismic events. The general problem of signal interpretation is formally described. The system uses an assumption based truth maintenance system. The advantages of using this approach for this application are described.

4202 Facilities And Equipment

REFER ALSO TO CITATION(S) 43032, 43201, 43202, 43269, 43274, 43469, 43558, 43603, 43630, 43860, 44599, 44630, 44714, 44743, 44745, 44787

43713 **(AD-A—180991/2/XAB) Experimental investigation of a magnetic refrigerator based on magnetically active regeneration. Final report, May 1984-May 1986.** Iwasa, Y.; Smith, J.L.; Taussig, C.P. (Massachusetts Inst. of Tech., Cambridge (USA). Cryogenic Engineering Lab.). Mar 1987. 131p. NTIS, PC A07/MF A01.

The concept of magnetically active regeneration is explored in a prototype magnetic refrigerator which has produced a refrigeration of 0.40 W at 3.79 K while rejecting 3.0 W to a 5.51 K sink. The prototype refrigerator consists of a gadolinium-gallium-garnet(Gd(3)Ga(5)O(12))regenerator core excited by an AC superconducting solenoid. A reversing flow of 3 atm supercritical helium carries the heat of magnetization to the hot reservoir and refrigerates the cold reservoir with the cooling of demagnetization.

43714 **(AD-A—181095/1/XAB) Development of an optical survivability coating. Phase 1. Final report.** (CVD, Inc., Woburn, MA (USA)). 29 Apr 1987. 38p. (CVD-TR—9076). NTIS, PC A03/MF A01.

A critical objective of the Strategic Defense Initiative (SDI) is the development of optical, particularly infrared, techniques to detect, acquire, and track space objects and ballistic missiles. In order for the infrared (IR) systems to detect these relatively cool objectives at suitable ranges (1000 km or more), it is necessary that they operate at the limit of detectivity. Such high sensitivity makes these systems very vulnerable to laser counter measures. Particularly sensitive are the focal plane detectors, focusing optics, and optical coatings, all of which have relatively low optical-damage thresholds.

43715 **(BDX—613-3721) Wire interconnection reliability and moisture levels in hybrid microcircuits with epoxy-attached components.** Blazek, R.J. (Allied Corp., Kansas City, MO (USA). Bendix Kansas City Div.). Jul 1987. Contract AC04-76DP00613. 19p. (CONF-8709114—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012987.

From International Society for Hybrid Microcircuits conference; Minneapolis, MN, USA (28 Sep 1987).

A hybrid microcircuit chip and wire technology was evaluated that consists of chip components attached by epoxy to either thin film or multilayer thick film networks and interconnected with gold wires. This technology was reviewed to qualify it for Department of Energy products, which must withstand long-term storage and extreme environmental requirements. The study included destructive wire pull testing, ball bond shear testing, internal moisture and material analysis, environmental testing, and accelerated aging. Wire pull strengths that averaged 8.92 g and ball bond shear strengths that averaged 44 g were similar, regardless of the HMC assembly, environmental, or aging conditions. Minimum wire pull strengths that met Mil-Std-883C requirements comprised 99.55% of the total wires, and average internal moisture levels met Mil-Std-883C requirements. Wire pull strengths did not decrease, and bond

delaminations and intermetallics did not increase after accelerated aging for 1000 hours at 150°C. An existing chip and wire technology will be upgraded by replacing the present component epoxy with one that generates lower moisture levels and contamination. Plasma cleaning components and networks before wire bonding also will improve wire reliability. Thermosonic wire bond schedules will be optimized for specific chip components, and intermetallic and epoxy contamination problems will be monitored with ball bond shear testing.

43716 (CONF-870656—23) Optically enhanced electron attachment and its possible application in diffuse discharge switches. Pinnaduwage, L.A.; Christophorou, L.G.; Hunter, S.R. (Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville (USA). Dept. of Physics). 1987. Contract AC05-84OR21400. 5p. NTIS, PC A02. File Number DE87011655.

From 6. Institute of Electrical and Electronic Engineers pulsed power conference; Arlington, VA, USA (29 Jun 1987).

Enhanced electron attachment due to electronically excited molecules produced by excimer laser light is reported. This effect may be utilized to alter the conductivity of a diffuse gas discharge using nanosecond laser pulses and, thus, has possible application in high-power gas switches.

43717 (CONF-870724—1-FP) EMP coupling to shielded cables. Agouridis, D.C. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011658.

From 24. annual conference on nuclear and space radiation in electronics; Snowmass, CO, USA (28 Jul 1987).

Electromagnetic coupling to shielded cables is analyzed in terms of two electromagnetically coupled transmission lines excited by distributed sources. These sources result in two traveling waves on the shield and four traveling waves in the core of the cable. Transient waveforms are reported from EMP coupling on an overhead RG-58 cable.

43718 (DOE/ID/12647—T1) Preliminary design report for the prototypical fuel rod consolidation system. Rosa, J.M. (Nutech Engineers, Inc., San Jose, CA (USA)). 3 Dec 1986. Contract AC07-86ID12647. 557p. NTIS, PC A24/MF A01; 1; GPO Dep. File Number DE87012422.

This report documents NUTECH's preliminary design of a dry, spent fuel rod consolidation system. This preliminary design is the result of Phase I of a planned four phase project. The present report on this project provides a considerable amount of detail for a preliminary design effort. The design and all of its details are described in this Preliminary Design Report (PDR). The NUTECH dry rod consolidation system described herein is remotely operated. It provides for automatic operation, but with operator hold points between key steps in the process. The operator has the ability to switch to a manual operation mode at any point in the process. The system is directed by the operator using an executive computer which controls and coordinates the operation of the in-cell equipment. The operator monitors the process using an in-cell closed circuit television (CCTV) system with audio output and equipment status displays on the computer monitor. The in-cell mechanical equipment consists of the following: (1) two overhead cranes with manipulators; (2) a multi-degree of freedom fuel handling table and its clamping equipment; (3) a fuel assembly end fitting removal station and its tools; (4) a consolidator (which pulls rods, assembles the consolidated bundle and loads the canister); (5) a canister end cap welder and weld inspection system; (6) decontamination systems; and (7) the CCTV and microphone systems.

43719 (DOE/ID/12651—T1-Vol.1) Prototypical spent fuel rod consolidation equipment preliminary design report: Volume 1, Report. (NUS Corp., Clearwater, FL (USA)). 1 Dec 1986. Contract AC07-86ID12651. 362p. NTIS, PC A16/MF A01; 1; GPO Dep. File Number DE87012418.

This design report describes the NUS Preliminary Design of the Prototype Spent Nuclear Fuel Rod Consolidation Equipment for the Department of Energy. The sections of the report elaborate on each facet of the preliminary design. A concept summary is provided to assist the reader in rapidly understanding the complete design. The NUS Prototype Spent Fuel Rod Consolidation System is an automatically controlled system to consolidate a minimum of 750 MT (heavy metal)/year of US commercial nuclear reactor fuel, at 75% availability. The system is designed with replaceable components utilizing the latest state-of-the-art technology. This approach gives the system the flexibility to be developed without costly development programs, yet accept new technology as it evolves over the next ten years. Capability is also provided in the system design to accommodate a wide variety of fuel conditions and to recover from any situation which may arise.

43720 (DOE/ID/12651—T1-Vol.2) Prototypical spent fuel rod consolidation equipment preliminary design report: Volume 2, Drawings. (NUS Corp., Clearwater, FL (USA)). 01 Dec 1986. Contract AC07-86ID12651. 146p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87012419.

This volume consists of 65 E size drawings and 4 sketches of the NUS spent fuel rod consolidation equipment. The drawings have been grouped into categories; a detailed list of the drawings is included. The sketches prepared during the preliminary design process have been included.

43721 (DOE/ID/12651—T1-Vol.3) Prototypical spent fuel rod consolidation equipment preliminary design report: Volume 3, Appendices. (NUS Corp., Clearwater, FL (USA)). 1 Dec 1986. Contract AC07-86ID12651. 414p. NTIS, PC A18. File Number DE87012420.

This volume deals with several design topics of the NUS spent fuel rod consolidation equipment. Areas covered include materials, processing time, cutting tools, quality assurance, and calculations. (JDH)

43722 (DOE/NE/37949—T2) Automatic seam welding with infrared sensor feedback. Grooms, K.; Chin, B.A. (Auburn Univ., AL (USA). Dept. of Mechanical Engineering). 15 Jun 1987. Contract FG05-85NE37949. 35p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013556.

An automatic seam tracking system has been developed which uses an infrared sensor as visual feedback. The infrared system determines torch seam error by observing changes in the thermal distribution surrounding the weld torch. This paper presents information concerning the design, implementation and testing of the system.

43723 (FNAL-TM—1377) Design charts for spacing of vacuum line supports. Western, J.L.; Krempetz, K.J. (Fermi National Accelerator Lab., Batavia, IL (USA)). 4 May 1987. Contract AC02-76CH03000. 10p. NTIS, PC A02/MF A01. File Number DE87013848.

This paper presents design tables and graphs to aid engineers and designers in the selection of support spacing for vacuum beam lines and other vacuum pipes. This data applies to support spacing for thin wall pipes and tubes under an internal vacuum (or open to atmosphere) and subject to external atmospheric pressure. Data is generated from the equations for a simply supported thin walled pipe or tube of circular cross section. These tables and graphs indicate what the minimum spacing of supports is for a pipe or tube of a given radius and supply data for carbon steel, stainless steel, aluminum and copper materials. The wall thickness of the pipe and tube is limited to 1/10 of the pipe radium ($T << R/10$). A thickness of R/10 results in a decrease in the length values in the attached tables of 10%, whereas a thickness of R/100 results in a decrease in the length values in the attached tables of 1%. Snow loads, wind loads, equipment loads, etc. are not included in the tables and graphs. This data is applicable for vacuum pipes or tubes under its own static deed weight.

43724 (FNAL-TM—1464) Simple instrumentation for testing of ceramic superconductors. Kuchnir, M.; Markley, F. (Fermi National Accelerator Lab., Batavia, IL (USA)). 17 Jun 1987. 6p. (CONF-8706125—11). NTIS, PC A02/MF A01. File Number DE87013849.

From Conference on advances in cryogenic engineering; St. Charles, IL, USA (14 Jun 1987).

In order to compare procedures for fabricating $YBa_2Cu_3O/sub\ 7-x/$ samples in a fast and convenient way we have used two inexpensive devices: a rather sensitive pendulum for indication of the amount of superconducting phase in the sample and a transformer for the measurement of critical current. Both devices are described in detail.

43725 **(FRT—81-J-0034) Study of the thermal resistance induced by the high temperature unsticking of finned tubes.** Pierrache, J.P.; Sandid, M.; Tournier, C. (Delegation Generale a la Recherche Scientifique et Technique (DGRST), 75 - Paris (France)). 1984. 38p. (In French). NTIS (US Sales Only), PC A03/MF A01. File Number DE87753151.

The aim of this study was to investigate the heat transfer rate evolution of various gilled pipes from Spiro-Gills as a function of temperature (from 200 to 600 degrees C.). The experimental transfer rates are shown to decrease much more rapidly when the temperature grows than as calculated. This phenomen is due to the thermal expansion difference between the tube and the fin, to the high temperature recristallization of the fin aluminium and to the heat modified tube-fin contact. It is shown that the double knurled gilled pipe have better performances than the crimped gilled pipe or the extruded gilled pipes.

43726 **(FRT—82-5-1085) Heat transfer surface fouling. Third phase report. Final and synthesis report.** Patureau, J.P.; Potivon, A. (Delegation Generale a la Recherche Scientifique et Technique (DGRST), 75 - Paris (France)). 1984. 52p. (In French). NTIS (US Sales Only), PC A04/MF A01. File Number DE87753149.

A two-step semi-empiric analysis is proposed for the study of the fouling mechanisms on heat exchanger surfaces. The first step is a physical modelization of the transport phenomena with emphasis on the fluid mechanics: convection, turbulence and diffusion. The second step is an experimental analysis of the in-situ behaviour of the particles; in a reasonable length of time, the characteristics of aggregation, entrainment, surface reactions, corrosion, micro-organisms, condensation, are measured with a fouling sensor set in the flow.

43727 **(JAERI-M—87-039) Structure-dependent matrix representation of manipulator kinematics and its inverse solution.** Sasaki, Shinobu. (Japan Atomic Energy Research Inst., Tokyo). Mar 1987. 31p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. File Number DE87752966.

In this paper, derivation of kinematic equations for a six-link manipulator is presented using the homogeneous transformation (A/sub i/-matrix) based on Denavit-Hartenberg method, and additionally a solution procedure of its inverse problem is outlined. In order to examine the validity of a system of equations, solutions were compared with the exact ones of the inverse kinematics (for the same type of a manipulator) expressed in arbitrarily given coordinate systems. Through complete agreement of joint solutions between the two, the present purpose was accomplished. As shown in this paper, an explicit description between adjacent links will give a possible clue to a systematic treatment of the inverse problem for a class of manipulators.

43728 **(LA-UR—87-1980) Three-dimensional computer modeling of particulate flow around dust monitors.** Nichols, B.D.; Gregory, W.S. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 9p. (CONF-8710102—2). NTIS, PC A02. File Number DE87011779.

From 3. mine ventilation symposium; University Park, PA, USA (12 Oct 1987).

SOLA-DM is a three-dimensional finite-difference computer code designed to model the dynamics of an incompressible fluid and the transport of discrete particulate material around obstacles impervious to flow. The numerical methods used in this code are described. SOLA-DM was used to predict the particle flux sampled by the 10-mm Dorr-Oliver Cyclone and MINIRAM dust monitors. Various geometric and dynamic variations of monitor and airflow combinations were tested. The code predictions are shown in computer-generated graphic plots.

43729 **(LA-UR—87-2199) Fast shock tube assemblies.** Steele, R.D.; Tan, Tai-Ho. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 5p. (CONF-870753—16). NTIS, PC A02. File Number DE87011732.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

Developed is a unique explosively driven devices to be used as fast-shock tubes or as particle launchers. Such drivers produce a highly symmetrical pressure wave that can be used to launch particles. Shocks in these devices of approximately 18 km/s have been achieved and there are plans to use these devices to accelerate particles in a "shockless" particle launch.

43730 **(LA-UR—87-2282) Characterization of a simple explosively driven particle acceleration.** Tan, T.H.; Fritz, J.N.; Marsh, S.P.; McQueen, R.G.; Steele, R.D. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 4p. (CONF-870753—63). NTIS, PC A02/MF A01; GPO Dep. File Number DE87013140.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

Experiments are carried out to characterize the performance of a compact cylindrical (2-inch x 3-inch-long) single-point detonation ring-lit fast shock tube that has been designed to accelerate particles to velocity in excess of 10 km/s. The experimental results from the study of propellant flow and plate acceleration will be presented and compared with the code calculation. Various interesting measurement techniques will also be discussed.

43731 **(LBL—23468) Cryogenic detection of particles: Development effort in the United States.** Sadoulet, B. (Lawrence Berkeley Lab., CA (USA)). May 1987. Contract AC03-76SF00098. 11p. (CONF-8703161—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012886.

From Workshop on cryogenic detectors; Munich, F.R. Germany (13 Mar 1987).

The development of cryogenic detectors of particles, with emphasis on large mass devices, has been reviewed. Most groups are still tooling up and exploring basic properties of sensors. The main discussion themes are summarized and some of the early experimental results are described.

43732 **(N—87-22199) Rotordynamic instability problems in high-performance turbomachinery, 1986.** (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Jan 1987. 548p. (CONF-8606333—; NASA-CP—2443; E—3136; NAS—1.55:2443). NTIS, PC A23/MF A01.

From Conference on rotordynamic instability problems in high-performance turbomachinery; College Station, TX, USA (2 Jun 1986).

The first rotordynamics workshop proceedings (NASA CP-2133, 1980) emphasized a feeling of uncertainty in predicting the stability of characteristics of high-performance turbomachinery. In the second workshop proceedings (NASA CP-2250, 1982) these uncertainities were reduced through programs established to systematically resolve problems, with emphasis on experimental validiation of the forces that influence rotordynamics. In third proceedings (NASA CP-2338, 1984) many programs for predicting or measuring forces and force coefficients in high-performance turbomachinery produced results. Data became available for designing new machines with enhanced stability characteristics or for upgrading existing machines. The present workshop proceedings illustrates a continued trend toward a more unified view of rotordynamic instability problems and several encouraging new analytical developments.

43733 (N—87-22199, pp vp) **Subsychronous vibration of multistage centrifugal compressors forced by rotating stall.** Fulton, J.W. Jan 1987. NTIS, PC A23/MF A01. (CONF-8606333—; NASA-CP—2443; E—3136; NAS—1.55:2443).

From Conference on rotordynamic instability problems in high-performance turbomachinery; College Station, TX, USA (2 Jun 1986).

A multistage centrifugal compressor, in natural gas re-injection service on an offshore petroleum production platform, experienced subsynchronous vibrations which caused excessive bearing wear. Field performance testing correlated the subsynchronous amplitude with the discharge flow coefficient, demonstrating the excitation to be aerodynamic. Adding two impellers allowed an increase in the diffuser flow angle (with respect to tangential) to meet the diffuser stability criteria based on factory and field tests correlated using the theory of Senoo (for rotating stall in a vaneless diffuser). This modification eliminated all significant subsynchronous vibrations in field service, thus confirming the correctness of the solution. Other possible sources of aerodynamically induced vibrations were considered, but the judgment that those are unlikely has been confirmed by subsequent experience with other similar compressors.

43734 (N—87-22199, pp vp) **Non-linear performance of a three-bearing rotor incorporating a squeeze-film damper.** Holmes, R.; Dede, M. Jan 1987. NTIS, PC A23/MF A01. (CONF-8606333—; NASA-CP—2443; E—3136; NAS—1.55:2443).

From Conference on rotordynamic instability problems in high-performance turbomachinery; College Station, TX, USA (2 Jun 1986).

This paper is concerned with the non-linear vibration performance of a rigid rotor supported on three bearings, one being surrounded by a squeeze-film damper. This damper relies on the pressure built up in the squeeze film to help counter-act external forces arising from unbalance and other effects. As a result a vibration orbit of a certain magnetude results. Such vibration orbits illustrate features found in other non-linear systems, in particular subharmonic resonances and jump phenomena. Comparisons between theoretical prediction and experimental observations of these phenomena are made.

43735 (N—87-22729) **Structural Dynamics and Control Interaction of Flexible Structures.** Ryan, R.S.; Scofield, H.N. (National Aeronautics and Space Administration, Huntsville, AL (USA). George C. Marshall Space Flight Center). Apr 1987. 729p. (CONF-8604346—Pt.2; NASA-CP—2467-PT-2; M—554-PT-2; NAS—1.55:2467-PT-2). NTIS, PC A99/MF E03.

From Structural dynamics and control interaction of flexible structures; Huntsville, AL, USA (22 Apr 1986).

A Workshop was held to promote technical exchange between the structural dynamic and control disciplines, foster joint technology, and provide a forum for discussing and focusing critical issues in the separate and combined areas. The workshop was closed by a panel meeting. Panel members' viewpoints and their responses to questions are included.

43736 (SAND—87-0128C) **Progress toward a superconducting opening switch.** Humphreys, D.R.; Francavilla, T.L.; Gubser, D.U.; Wolf, S.A. (Sandia National Labs., Albuquerque, NM (USA); Naval Research Lab., Washington, DC (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-870656—44). NTIS, PC A02/MF A01; GPO Dep. File Number DE87014170.

From 6. Institute of Electrical and Electronic Engineers pulsed power conference; Arlington, VA, USA (29 Jun 1987).

Recent developments in superconducting materials should be of interest to the pulsed power community. Nitride films have been made which can carry high currents ($\sim$10 MA/cm^2) in their superconducting state, yet which have a moderately high resistivity ($\sim$100 $\mu\Omega$-cm) in their normal state. Laser light of moderate energy triggers the transition in nanoseconds. The new high-temperature oxide superconductors show promise of having similar critical current densities but higher normal-state resistivities ($\sim$1000 $\mu\Omega$-cm). These properties raise the possibility of making a superconducting fast opening switch. In conjunction with superconducting inductive energy storage ($\sim$100 MJ/m^3), such a switch could provide the basis for very compact Terawatt pulsed power generators. Here we show some of the possible configurations, physical constraints, and scaling laws for such systems.

43737 (UCID—20987) **Downhole delay and Delamar.** George, L.L. (Lawrence Livermore National Lab., CA (USA)). 4 Mar 1987. Contract W-7405-ENG-48. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012311.

In this report, the reliability of the downhole portion of the Delamar cooling and purge systems is estimated and recommendations to improve the reliability estimate are made. Reliability is the probability that the test does not fail. The reliability estimate shows that the important failure events are delays, leaks, pumps, the heat exchanger, and the purge system. The cooling and purge systems cause test failure if temperature or humidity get outside limits. The event sequence diagrams and worksheets in this report and problem diagnosis and planning during test preparations. The control and power cables and the uphole control system are not included in the reliability estimate.

43738 (UCRL—94675) **Thermo-optical modeling of flashlamp-pumped zig-zag slabs.** Gelinas, R.J.; Doss, S.K.; Murty, S.S. (Lawrence Livermore National Lab., CA (USA)). 1 Dec 1986. Contract W-7405-ENG-48. 5p. (CONF-861038—10). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011878.

From OSA/APS international laser science conference; Seattle, WA, USA (20 Oct 1986).

This article describes the thermo-optical mechanics of wave front phase distortions in flashlamp-pumped, convectively cooled zig-zag slabs. Identified are both computations and laboratory measurements, the causes of beam phase distortions that are frequently observed in output beams from zig-zag slabs.

43739 (UCRL—95843) **Design and analysis of a broadband TM_{01} mode generator in cylindrical waveguide.** Burkhart, S. (Lawrence Livermore National Lab., CA (USA)). 1986. Contract W-7405-ENG-48. 8p. (CONF-8607330—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011308.

From 2. international microwave symposium; Rio De Janeiro, Brazil (27 Jul 1986).

A generator for launching the TM_{01} mode in a cylindrical waveguide is described. Two-dimensional modeling demonstrated a mode purity (TM_{02}/TM_{01} mode) in excess of 20 dB across most of the design 6 to 10 GHz. Testing of two fabricated generators showed that good mode purity was obtained in practice.

43740 (UCRL—96398) **Electromagnetic ring expansion as a high-rate test: Experimental development.** Gourdin, W.H.; Weinland, S.L.; Boling, R.M. (Lawrence Livermore National Lab., CA (USA)). 7 Jul 1987. Contract W-7405-ENG-48. 6p. (CONF-870753—50). NTIS, PC A02. File Number DE87013486.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

We describe improvements to the electromagnetically launched expanding ring experiment that makes it reproducible, analyzable, and amenable to the rapid testing of many specimens. Primary concerns are the design and containment of the solenoid, high-voltage switching of the capacitor, and electromagnetic and expansion-speed diagnostics. We demonstrate the reproducibility of the technique on carefully processed OFHC copper rings.

43741 **Short, flexible ultrahigh vacuum thermal and electrical conductor.** Fowler, G.L. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 5: No. 5, 2976-2977(Sep 1987). Contract AC04-76DP00789.

A procedure is described for fabrication of a short, flexible ultrahigh vacuum thermal and electrical conductor for cryogenic applications.

43742 **On the theory of Josephson tunneling into a proximity system.** Kresin, V.Z. (Materials and Molecular Research Div., Lawrence Berkeley Lab., Univ. of California, Berkeley, CA 94720). pp 198-215 of Josephson effect: Achievements and trends. Barone, A. Teaneck, NJ; World Scientific Pub. Co. (1986). Contract AC03-76SF00098.

The properties of a Josephson junction containing a proximity system are discussed. The value of the maximum dc Josephson current I/sub M/(T) depends strongly on the parameters of the proximity system. If N is a semiconducting film, the value of I/sub M/ is affected by incident radiation. If N is a size-quantizing semimetal film, I/sub M/ becomes an oscillating function of the thickness L/sub N/. The weak link is formed by the inversion layer and I/sub M/ is controlled by the applied field.

4203 Lasers

REFER ALSO TO CITATION(S) 43168, 43857, 44748

43743 **(AD—917927/6/XAB) Low-absorption coating technology. Final report, 22 May 1972-22 May 1973.** Braunstein, M. (Hughes Research Labs., Malibu, CA (USA)). Mar 1974. 129p. NTIS, PC A07/MF A01.

Distribution limitation now removed.

The results reported here represent significant advances in the state of the art of high-power laser reflectors. An improvement in the absorptance for the enhanced reflectivity multilayer dielectric mirrors from 0.005 at 10.6 micrometers at the beginning of the study to a value as low as 0.0012 at 10.6 micrometers for Ag/(ThF4/CdTe) was achieved. The absorptance improvement from 0.005 to 0.0012 has been shown to be due to improvements in the purity of the ThF4 and CdTe dielectric materials; film deposition techniques are shown to be critical and must be carefully controlled. Further improvements in material purity or film deposition techniques can be expected to lower absorptance even more. Results are presented for a variety of new coatings with potential application at 10.6 micrometers . These coatings include the promising reflector Al/(KCl/As_2S_3) which has shown 0.0016 absorptance and a high-energy density damage threshold of about 50J/sq cm. Results are presented from the laser damage study for damage thresholds for the coatings and reflectors produced during the course of the program. The program goal, which was to produce reflectors having 99.9% reflectance at 10.6 micrometers was almost met by achieving 99.88% for a Ag/(ThF_4/CdTe) reflector. Rigorous control of starting materials used for the coatings and the deposition techniques was found to be essential for the preparation of the high-reflectance, low-absorptance coatings.

43744 **(AD-A—180617/3/XAB) Chemical stabilization of laser dyes. Final report, 1 December 1984-28 February 1987.** Koch, T.H. (Colorado Univ., Boulder (USA). Dept. of Chemistry). 7 May 1987. 9p. NTIS, PC A02/MF A01.

Coumarin laser dyes upon excitation degrade to produce products that absorb at the lasing wavelength. This results in attenuation of dye laser output through interference of stimulated emission. The roles of singlet oxygen and excitation intensity on dye degradation were explored. Singlet oxygen is formed but its reactions with the dye do not appear to be a major cause of dye laser output deterioration. High light intensity results in dye-sensitized, solvent oligomerization to yield materials that interfere with dye-stimulated emission. 1, 4-Diazabicyclo2,2,2octane (DABCO)inhibits this oligomerization.

43745 **(AD-A—180715/5/XAB) On-wafer testing of GaInAsP/InP mass-transported lasers.** Walpole, J.N.; Liau, Z.L. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 1986. 4p. (MS—7223). NTIS, PC A02/MF A01.

Pub. in SPIE, V723. Progress in Semiconductor Laser Diodes, 100-102(1986).

Techniques are reviewed for on wafer testing of diode lasers. Previously described are the fabrication of mass-transported buried heterostructure lasers in which the laser cavity is produced within the mesa structures in such a way that electrical isolation between laser mesas on the wafer is essentially built in. Bars of lasers in linear edge emitting arrays can be cleaved from such a wafer. CW electrical and optical characterization of each laser are carried out (up to about 50 devices in a row) in these bars without bonding to heat sinks. Individual elements of two dimensional arrays of surface-emitting lasers are fabricated using etched and mass-transported cavity mirrors with monolithically integrated beam deflectors. This kind of on wafer testing permits selection of suitable individual devices to be diced and bonded or selection of segments of wafers for optimum array performance. It also makes possible the correlation of device performance with position on the wafer, which is useful in diagnosing problems in wafer growth and fabrication.

43746 **(AD-A—180788/2/XAB) Small-signal modulation of p-substrate mass-transported GaInAsP/InP lasers.** Tsang, D.Z.; Liau, Z.L. (AN Ukrainskoj SSR, Kiev. Inst. Fizicheskoj Khimii). 1986. 6p. (MS—7124C). NTIS, PC A02/MF A01.

Pub. in SPIE Progress in Semiconductor Laser Diodes, Vol. 723, 50-54(1986).

The modulation characteristics of GaInAsP diode lasers grown on p-type substrates were studied on devices in which the parasitic bonding pads were eliminated. The lasers have thresholds as low as 4.5 mA. The small-signal sinusoidal response is comparable to similar lasers made on n-type substrates. A small-signal -3 dB frequency as high as 16.4 GHz was measured with a 175-micrometer-long laser.

43747 **(AD-A—180821/1/XAB) Ultrastable carbon dioxide (CO_2) lasers.** Freed, C. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 1986. 11p. (MS—7325). NTIS, PC A02/MF A01.

Pub. in SPIE v709 Laser Research and Development in the Northeast, 36-45(1986).

This paper reviews the spectral purity, frequency stability, and long-term stabilization of CO_2 isotope lasers developed at MIT Lincoln Laboratory. Extremely high spectral purity and short-term stability of less than 1.5×10^{13} have been achieved and are discussed. A long-term stabilization technique, which was used to line-center lock any regular or hot-band CO_2 isotope laser transition, is described. A brief description on using CO_2 lasers as secondary frequency standards is also given.

43748 **(AD-A—180851/8/XAB) High-spectral-purity c-w and pulse output from an ensemble of discrete diode lasers.** Anderson, K.K.; Rediker, R.H. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 5 Jan 1987. 4p. (JA—5922). NTIS, PC A02/MF A01.

Pub. in Applied Physics Letters, Vol. 50, No. 1, 1-3, (5 Jan 87).

The spectrum of the output from an external-cavity laser containing five discrete diode lasers operating as a coherent ensemble was shown to correspond to a single mode of the cavity with very narrow linewidth. For cw operation, the linewidth is within the 7.5-MHz measurement resolution. Pulsed outputs from a low-level cw baseline are reported for which the single-mode pulse output is also within the 7.5-MHz measurement resolution. The measured linewidth of the single-mode pulse output with no cw output is 9 MHz.

43749 **(AD-A—180884/9/XAB) Competition between amplified spontaneous emission and the four-wave-mixing process.** Boyd, R.W.; Malcuit, M.S.; Gauthier, D.J.; Rzazewski, K. (Rochester Univ., NY (USA). Inst. of Optics). 15 Feb 1987. 13p. NTIS, PC A02/MF A01.

Pub. in Physical Review A, Vol. 35, No. 4, 1648-1658(15 Feb 1987).

Competition between amplified spontaneous emission (ASE) and the four-wave mixing (FWM) process was observed under conditions of two-photon resonant excitation of the sodium 3d level. The nature of the competition is that the FWM process is able to prevent the occurrence of ASE, even though the gain of the ASE process calculated in the absence of competition is that of FWM. The ASE is suppressed because the fields generated by the FWM process create a new excitation pathway connecting the ground the 3d levels, and under quite general conditions this pathway interferes destructively with that due solely to the applied laser field. These effects are modeled theoretically by solving perturbatively

the density matrix equations of the atomic system, thereby determining the population in the upper level and nonlinear polarization of the medium. The coupling between the various optical fields due to the nonlinear polarization is described by coupled-amplitude equations. The coupling between the various optical fields due to the nonliner polarization is described by coupled-amplitude equations. The solution to these equations predicts that, when the wave vector mismatch is not too large, the fields evolve spatially to reach steady-state values, and that the population excited to the 3d level by the total steady-state optical field is much smaller than that due to the incident laser field alone.

43750 **(AD-A—180887/2/XAB) Large monolithic two-dimensional arrays of GaInAsP/InP surface-emitting lasers.** Liau, Z.L.; Walpole, J.N. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 2 Mar 1987. 4p. (JA—5951). NTIS, PC A02/MF A01.

Pub. in Applied Physics Letters, Vol. 50, No. 9, 528-530(2 Mar 1987).

A 1 mm x 3 mm monolithic two-dimensional array (incoherent) of 112 mass-transported buried-heterostructure lasers with integrated beam deflectors was fabricated with good uniformity. An average cw output of 14 mW per laser and an average optical flux of 57 W/sq cm were obtained when the array is operated one section (approximately 14% of the total area) at a time. The total cw output of the entire array is thermally limited to 0.7 W.

43751 **(AD-A—180923/5/XAB) Analysis of radiation focusing and guiding in the free-electron laser by use of a source-dependent expansion. Interim report.** Sprangle, P.; Ting, A.; Tang, C.M. (Berkeley Scholars, Inc., CA (USA)). 20 Apr 1987. 44p. NTIS, PC A03/MF A01.

In the free-electron laser (FEL) the resonant interaction between the radiation field and electron beam can result in radiation focusing (optical guiding). If the centroid of the electron beam is transversely displaced off-axis, the radiation field, under certain conditions, will follow and be steered by the electron beam. The effect of a spatial modulation on the electron-beam envelope can also modify the propagation characteristics of the radiation. These and other phenomena are analytically and numerically studied using a novel source-dependent Laguerre-Gaussian modal representation of the fully three-dimensional radiation field. Unlike the vacuum Laguerre-Gaussian modal expansion, the longitudinal spatial dependence of the radiation waist and curvature are determined and characterized by the source term in the wave equation. Among the advantages of this general source-dependent-expansion (SDE) approach is that few modes are needed to accurately describe the radiation. Hence, fast and accurate numerical solutions of the fully three-dimensional FEL problem can be obtained over distances of many Rayleigh lengths. Furthermore, this expansion allows development of an envelope equation for the radiation beams as well as an expression for the centroid of the beam.

43752 **(AD-A—180926/8/XAB) Research and development of photon-activated thermionic cathodes for excimer lasers. Final report, 1 October 1984-30 May 1985.** Oettinger, P.E. (Thermo Electron Corp., Waltham, MA (USA)). Oct 1986. 142p. (TE—4362-152-85). NTIS, PC A07/MF A01.

A combined experimental and analytical study was designed to determine whether electron emission from thermally pulsed laser-heated cesiated surfaces is due to thermally non-equilibrated thermionic effects, and, if so, to provide a description of the relevant physical processes and their limitations. The experiments were performed with specific pulses of laser radiation incident on tungsten surfaces immersed in a low-pressure cesium vapor. The measurements indicated that thermionically generated space charge limited currents are generated, and that their magnitudes could only be accounted for by thermal-nonequilibrium effects. The rapidly rising current pulses were often observed to transition into a plasma dominated flow that could be curtailed by diode charges. These experiments and conclusions are discussed in this report in more detail.

43753 **(AD-A—180977/1/XAB) Proof of the feasibility of coherent and incoherent schemes for pumping a gamma-ray laser. Quarterly technical progress report, 1 January-31 March 1987.** Collins, C.B. (Texas Univ., Richardson (USA). Center for Quantum Electronics and Applications). Apr 1987. 79p. (UTD-GRL—8602). NTIS, PC A05/MF A01.

Recent approaches to the problem of the gamma-ray laser have focused upon upconversion techniques in which metastable nuclei are pumped with long-wavelength radiation. At the nuclear level the storage of energy can approach tera-joules (10^{12} J per liter for thousands of years). However, any plan to use such a resource for a gamma-ray laser poses problems of a broad interdisciplinary nature requiring the fusion of concepts taken from relatively unrelated fields of physics. This research group has described several means through which this energy might be coupled to the radiation fields with cross sections for stimulated emission that could reach 10^{-17} sq. cm. Such a stimulated release could lead to output powers as great as 3×10^{21} watts/liter. Since 1978 they have pursued an approach for the upconversion of longer wavelength radiation incident upon isomeric nuclear populations that can avoid many of the difficulties encountered with traditional concepts of single-photon pumping. Recent experiments have confirmed the general feasibility and have indicated that a gamma-ray laser is feasible if the right combination of energy levels and branching ratios exists in some real material. Of the 1986 distinguishable nuclear materials, the present state-of-the-art has been adequate to identify 29 first-class candidates, but further evaluation cannot proceed without remeasurements of nuclear properties with higher precision.

43754 **(AD-A—181015/9/XAB) Optical properties of compressible inhomogeneous shear layers relevant to high-power lasers. Annual report, February 1985-March 1986.** Christiansen, W.H. (Washington Univ., Seattle (USA)). 30 Apr 1987. 13p. NTIS, PC A02/MF A01.

Shear layers and wakes are a major source of optical degradation in flow lasers. The structure of these flows are being studied experimentally with special attention given to their optical properties. Gases with difference refractive indices are being investigated, and the effects of density ratio and Mach number on optical performance are being measured.

43755 **(AD-B—017279/1/XAB) Laser system reliability. Final report.** Dueweke, P.W.; Smith, R.M.; Spreen, D.E. (BDM Corp., Albuquerque, NM (USA)). Mar 1977. 165p. (BDM/A—233-76-TR). NTIS, PC A08/MF A01.

Distribution limitation now removed.

A study was conducted to develop techniques for considering reliability in the HEL (High Energy Laser) program at the Air Force Weapons Laboratory. This effort was specifically oriented toward developing reliability methodologies rather than toward performing complete reliability analyses with accurate numerical predictions. A reliability model was developed and a sufficiently detailed failure data base was established to allow application of the model to the three principal HEL systems under consideration: the GDL (gas dynamic laser), the CL (chemical laser), and the EDL (electrical discharge laser). Then methodologies were developed for treating the interactions of reliability with such closely related factors as life cycle cost and combat effectiveness. This philosophy resulted in a study with an extremely wide scope, but with a very low level of detail.

43756 **(AD-B—031757/8/XAB) Calorimeter to measure the 10.6-micrometer absorption of metal-substrate mirrors. Final report.** Saito, T.T.; Callender, A.B.; Simmons, L.B. (Air Force Weapons Lab., Kirtland AFB, NM (USA)). Dec 1977. 64p. (AFWL-TR—76-63). NTIS, PC A04/MF A01.

Distribution limitation now removed.

An instrument was designed, constructed, and tested to calorimetrically measure the 10.6-micrometer absorption coefficient, alpha, of high-reflectivity metal-substrate mirrors. Optical, electrical, and thermal design considerations are discussed. The techniques of absorption measurement presented include the in-situ heat capacities, the reflected and absorbed laser light energies to an accuracy of + or - 4%, and the simplified data-reduction technique. Detailed operating instructions, data-reduction methods, and other

information (e.g., electrical schematics) required for an operational understanding of the measurement system are included. This report may also serve as an instruction manual. An error analysis indicates that the accuracy is + or - 0.1 alpha and the precision is 0.0005 alpha. Comparative measurements on the same mirrors by different reflectivity and absorption devices and extensive absorption data on state-of-the-art 10.6-micrometer metal-substrate mirrors are presented. The smallest absorption that was measured is 0.0010 for a gold-coated multi-dielectric enhanced mirror.

43757 **(LA-UR—87-2118) Electron beam requirements for soft x-ray/XUV free-electron lasers.** Goldstein, J.C. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 18p. (CONF-8703149—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011750.

From Workshop on low emittance beams; Upton, NY, USA (1 Mar 1987).

A discussion of the electron beam quality (peak current, energy spread, and transverse emittance) required to drive short-wavelength free-electron lasers in the XUV (10-100 nm) and soft x-ray (<10 nm) optical wavelength ranges is presented.

43758 **(UCID—21078) Coupled Maxwell-Bloch equations for pulsed Raman transitions.** Shore, B.W.; Sacks, R.; Karr, T. (Lawrence Livermore National Lab., CA (USA)). 15 May 1987. Contract W-7405-ENG-48. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013572.

As part of a comprehensive examination of equations describing pulsed laser propagation, this memo presents the coupled partial differential equations that describe the propagation of radiation pulses through a vapor of randomly placed molecules that respond by Raman excitation.

43759 **(UCRL—95611) Large-scale stimulated rotational Raman scattering experiments using the LLNL Nova laser.** Murray, J.R. (Lawrence Livermore National Lab., CA (USA)). 23 Oct 1986. Contract W-7405-ENG-48. 11p. (CONF-8610208—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012661.

From Workshop on nonlinear optical techniques for SDI applications; Albuquerque, NM, USA (28 Oct 1986).

The LLNL Nova laser is a ten-beam neodymium-glass laser system which can generate up to 15 kJ per beam in a few nanoseconds. Stimulated rotational Raman scattering (SRRS) in air limits the power delivered to one of the two target chambers of the laser if the beams are allowed to propagate in air over the entire distance. We have therefore conducted experiments using Nova to study the growth and properties of SRRS in air to assess its importance for Nova, future fusion lasers. Our early experimental results were published last November (Opt. Lett., 10, 565 (1985)). These show that the growth of SRRS from amplified spontaneous emission (ASE) in a high Fresnel number geometry is in agreement with predictions from calculated gains, and that the near-field distribution of the Raman-shifted radiation is a divergent beam with a fine speckle structure.

43760 **(UCRL—95670) Experimental characteristics of a high-gain free-electron laser amplifier operating at 8-mm and 2-mm wavelengths.** Throop, A.L.; Orzechowski, T.J.; Anderson, B.R.; Chambers, F.W.; Clark, J.C.; Fawley, W.M.; Jong, R.A.; Halbach, K.; Hopkins, D.B.; Sessler, A.M. (Lawrence Livermore National Lab., CA (USA); Lawrence Berkeley Lab., CA (USA)). 8 Jun 1987. Contract W-7405-ENG-48. 38p. (CONF-870622—9). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012628.

From 19. fluid dynamics, plasma dynamics, and laser conference; Honolulu, HI, USA (8 Jun 1987).

The Electron Laser Facility (ELF) at the Lawrence Livermore National Laboratory (LLNL) uses a high-current induction linac (3.5 MeV, 1000 A), in conjunction with a pulsed electromagnetic wiggler (4.0 M, 4000 G), to operate a free electron laser (FEL) that produces intense radiation in the microwave regime (2 to 8 mm). ELF is a high-gain, single-pass amplifier, using a commercial microwave source as an oscillator input (200 W-50 kW). Previous experiments at 35 GHz produced exponential gains of 40 dB/m, peak powers exceeding 1 GW, and beam-to-rf conversion efficiencies of 34%. Recent experiments at 140 GHz have demonstrated exponential gains of 22 dB/m, peak powers exceeding 50 MW, and total gains of 65 dB. In this paper, we describe the experimental results at these two frequencies and compare then with the predictions of simulation codes.

43761 **(UCRL—95849) Induction linac-driven free-electron lasers: Status and future prospects.** Prosnitz, D. (Lawrence Livermore National Lab., CA (USA)). 11 Jan 1987. Contract W-7405-ENG-48. 5p. (CONF-870132—16). NTIS, PC A02. File Number DE87012914.

From OE/LASE '87; Los Angeles, CA, USA (11 Jan 1987).

The high repetition rate and low single-pass gain inherent in an rf-driven Free Electron Laser (FEL) dictate that the laser system be configured as an oscillator. This allows the laser's electric field to build up over many passes around a high Q cavity. By way of contrast, the high-current capability of the Induction Linac (IL) system permits high single-pass optical gain, but the relatively low duty factor precludes oscillator operation; the pulses are neither long enough nor often enough to permit a field to accumulate in a cavity. The IL is thus configured as a MOPA (master oscillator/power amplifier) with a conventional laser serving as the MO. This report concentrates on the status of IL-driven FEL research at LLNL and gives a description of several applications for the high-peak-power radiation produced by an induction linac FEL.

43762 **Efficient generation of 200-nm light in β-BaB_2O_4.** Glab, W.L.; Hessler, J.P. (Argonne National Laboratory, Chemistry Division, Argonne, IL 60439). *Applied Optics;* **26**: No. 16, 3181-3182(15 Aug 1987).

Efficient generation of 200-nm light is achieved in β-BaB_2O_4 through third harmonic generation of pulsed dye-laser radiation. (AIP)

43763 **Multiplex electric discharge gas laser system.** Laudenslager, J.B.; Pacala, T.J. (to Administration of the National Aeronautics and Space Administration, Washington, DC). US Patent 4,677,636. 30 Jun 1987. Filed date 23 Oct 1985. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

This patent describes a multiplex pulsed electric discharge gas laser system comprising: (a) a housing; (b) pulsed electric transverse discharge gas lasers supported in the housing, each laser being arranged to produce a separate optical output; (c) a separate power supply individually associated with each laser for providing high energy excitation pulses to the associated laser to cause the laser to produce an optical output; (d) control means coupled to each power supply for controlling the application of excitation pulses to each laser. The lasers can be fired simultaneously or in a desired sequence and at a desired repetition rate, and the resulting multiple optical output beams can be combined or utilized separately.

43764 **Means for phase locking the outputs of a surface emitting laser diode array.** Lesh, J.R. (to National Aeronautics and Space Administration, Washington, DC). US Patent 4,677,629. 30 Jun 1987. Filed date 30 Sep 1985. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

An array of injection phase-locked diode lasers is described utilizing as a master a separate laser source, and means for coupling light from the master laser source into each diode laser of the array of diode lasers. The array is fabricated in a body of semi-conductor material. Each diode laser has a back facet on one side of the body of semiconductor material and a front facet on an opposite side of the body of semiconductor material. The light coupling means comprises a hologram prepared for producing from the output of the master laser source a set of distinct, spatially separated beams, each one directed into the back facet of each diode laser . To assure emission of phase coherent light from the array of diode lasers, the hologram is positioned between the master laser source and the one side of the body of semiconductor material. The hologram is prepared by illuminating a holographic emulsion plate with an image of the array of diode lasers using coherent light of substantially the same wavelength as the master laser source, and a co-

herent reference beam of substantially the same wavelength as the master laser source.

43765 **Pulsed digital multiplex laser generator.** Honeycutt, T.E.; Roberts, T.G. (to Secretary of the Army, Washington, DC). US Patent 4,677,398. 30 Jun 1987. Filed date 25 Jul 1985. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A pulsed digital multiplex laser generator, comprising: optical signal sources operating at respectively different frequencies; pulse coded digital input signal sources; respective modulators coupled to optical signal sources and being responsive to pulse coded input signals to pulse code modulate the output of the optical signal sources to provide a set of digitally modulated optical frequency components; means for combining the set of optical frequency components into a composite optical signal; and an output laser system operable in a pulsed mode of operation and being responsive to the composite optical signal and being preloaded by the frequency components to generate a single pulsed output beam containing the frequency components.

43766 **Atomic data for highly charged ions. Applications to X-ray laser design and thermonuclear fusion.** Younger, S.M. (Lawrence Livermore National Lab., CA). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **24/25**: No. 1, 373-376(Apr 1987). (CONF-861114—).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

A detailed understanding of a myriad of atomic processes is proving important for the development of short wavelength lasers and to the achievement of controlled thermonuclear fusion. A brief overview of some X-ray laser design issues is presented along with a discussion of relevant atomic data needs. Special attention is given to the need for experimental verification of rate coefficient data which are important for determining laser kinetics. Approaches to magnetic and inertial confinement fusion are reviewed with emphasis on atomic processes affecting both fuel burn and plasma diagnostics. Recent advances in the development of high power ICF drivers, both lasers and particle beams, are shown to suggest new areas of research involving very highly charged ions in dense hot plasmas.

4204 Heat Transfer And Fluid Flow

REFER ALSO TO CITATION(S) 43204, 43312, 43340, 43363, 43368, 43434, 43505, 43725, 43726, 44451

43767 **(AD-A—180774/2/XAB) Numerical technique for the solution of a vaporizing fuel droplet. Report for October 1985-October 1986.** Patnaik, G.; Sirignano, W.A.; Dwyer, H.A.; Sanders, B.R. (California Univ., Irvine (USA). Dept. of Mechanical Engineering). 1985. 10p. NTIS, PC A02/MF A01.

Pub. in ICDERS (10th), 253-266(4-9 Aug 85).

This study deals with the behavior of a fuel droplet in a hot gas stream. Models exist of single-droplet. A study by Prakash and Sirignano that included slip and internal circulation has shown the importance of convection. A fully numerical solution obtained by Dwyer and Sanders assumes an incompressible gas phase, and thus its application to situations with high temperature or concentration gradients is difficult. The technique now being developed is designed to handle variable density, two-phased flows. In addition, the method is sufficiently general to handle arbitrary æisymmetric flows. This technique has been applied to several cases of single-droplet vaporization in a convecting environment. A detailed picture of the transport processes throughout the droplet lifetime has been obtained. Due to drag, the dominance of convection on transport processes gives way to diffusion. Most earlier models assume the dominance of one mode or the other. A parameter survey with this technique will determine the regimes in which simpler models can be used and yield correlations that can be included in droplet spary calculations.

43768 **(AD-A—180839/3/XAB) Formulation of spray combustion models: resolution compared to droplet spacing. Report for October 1985-October 1986.** Sirignano, W.A. (California Univ., Irvine (USA). Dept. of Mechanical Engineering). Aug 1986. 8p. NTIS, PC A02/MF A01.

Pub. in Jnl. of Heat Transfer, Vol. 108, 633-639(Aug 1986).

Formulations of the governing equations for burning air/fuel spray mixtures are discussed. The subsystem of equations describing liquid properties is formulated in three ways: Eulerian description, Lagrangian description, and probabilistic or distribution function description. The relationships among these approaches and the relative advantages and disadvantages are discussed. The reduction of numerical error, the ability to resolve multivalued solutions, and the ability to achieve resolution a scale smaller than droplet spacing lead to a preference of the Lagrangian method over the Eulerian method. However, when resolution is is desired on a scale smaller than the average droplet spacing, the location of each droplet is known only in a statistical manner. The advantages of a probabilistic formulation in this case are evaluated.

43769 **(AGARD-CP—01) Transonic and Supersonic Phenomena in Turbomachines.** (Advisory Group for Aerospace Research and Development, 92 - Neuilly-sur-Seine (France)). Mar 1987. 374p. (CONF-8609318—). NTIS, PC A16/MF A01.

From Conference on transonic and supersonic phenomena in turbomachines; Munich, F.R. Germany (10 Sep 1986).

The Specialists' Meeting was arranged in the following sessions: Experimental Data on Shock Structures; Shock Induced Losses Including Shock Boundary Layer Interaction; Computational Results; and Blade Design Methods. In order to maintain high efficiency and reliability of advanced engines with high speed in compressors and turbines, a deep understanding of the influence of transonic and supersonic phenomena is essential. The meeting was aimed at providing a contribution to this goal.

43770 (AGARD-CP—01, pp vp) **Fundamental studies on shock-wave/boundary-layer interactions in a 3-D channel.** Benay, R.; Pot, T.; Delery, J. Mar 1987. NTIS, PC A16/MF A01. (CONF-8609318—).

From Conference on transonic and supersonic phenomena in turbomachines; Munich, F.R. Germany (10 Sep 1986).

Detailed experimental data on shock-wave/boundary-layer interaction in 3-D flows is still relatively scarce. This fact brought ONERA to undertake experiments in view of producing as complete a literature as possible on a three-dimensional transonic channel flow with shock. The test set-up is a channel with a 100 x 120 mm inlet section. The lower wall of the channel is humped while the other three faces are flat. In operation, a continuous supersonic flow is started and shock recompressions formed on the descending part of the hump. The flow in the interaction region was carefully analyzed by using, in particular, a three-color LDV system. The tests brought out a strongly three-dimensional flow structured very differently from the one observed in 2-D channel flows. It was revealed that in the presence of the strong adverse pressure gradient of the shock, a 3-D boundary layer tends to thicken less than a 2-D boundary layer, since the flow can reorganize in a much more complex fashion in the three directions of space. The precise data obtained were analyzed to arrive at a better understanding of the phenomena from a physical point of view, and also constitute a data base for validating the calculation models being developed.

43771 **(CONF-870712—4) Blowdown of two-component gas mixtures in branching systems.** Solbrig, C.W. (Argonne National Lab., Idaho Falls, ID (USA)). 1987. Contract W-31109-ENG-38. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87011392.

From Numerical methods in laminar and turbulent flow; Montreal, Quebec, Canada (6 Jul 1987).

A transient multi-volume, two-component model has been developed which is capable of describing the blowdown of gases through a piping system suddenly opened to the atmosphere. The volumes are connected through orifices or nozzles with recovery sections and in tee configurations as well as a single string. Two gas components are included in the model and exhaust into a third component such as air. Motion of a concentration front is modelled

and a polytropic process represents the state of the gas in each volume. An implicit solution is required since explicit numerical solutions are unstable for these equations. The iterative method developed for the equations converges in a variety of ill-posed situations. Results compare well with data. The large difference in the critical velocities of the gases results in very unusual and difficult to model depressurization histories. A local minimum in the pressure is observed followed by a later maximum.

43772 **(DOE/ER/13597—1) Experimental and theoretical studies of vertical annular liquid jets: Technical report No. 1.** Chigier, N.; Ramos, J.I.; Sun, T.Y. (Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Mechanical Engineering). Apr 1987. Contract FG02-86ER13597. 244p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE87013907.

This report presents information on research being conducted on annular liquid jets. The fluid mechanics of liquid curtains are being studied experimentally. This includes measurement of liquid film thickness, liquid film velocity and convergence length as a function of curtain diameter, nozzle gap width, liquid flow rate, and variation of physical properties of the liquid. A mathematical model, based on analytical and numerical solutions, which accounts for gravity, surface tension, pressure differences and exit nozzle geometry is presented in this report. (JDB)

43773 **(INIS-mf—10756) Investigations of droplet size determination.** Hawighorst, A. (Hannover Univ. (Germany, F.R.). Fakultaet fuer Maschinenwesen). 7 Jun 1985. 120p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE87752448.

In the context of safety investigation of light watercooled nuclear reactors, there could be spray flow in the reactor core during a hypothetical emergency cooling case. In the context of this work, investigations were carried out to determine the droplet spectra in the area of the fuel element head. The aim of these investigations was to make a contribution to the better understanding of droplet carryover and the resettlement of droplets in the top core region of the reactor. The possible measuring processes to determine droplet size distribution were first critically compared. A photographic process was selected as the method of measurement. A specially developed measuring device was used, in order to record droplet spectra in different flow conditions. In order to evaluate the photographs, a process based on digital picture evaluation was developed, which makes it possible to automate the analysis and to make the results reproducible. Using an extensive computer program, the diameters of the droplets sufficiently focussed in the picture are determined.

43774 **(LA-UR—87-1981) Node-based network analysis and its application to mine ventilation.** Gregory, W.S.; Nichols, B.D.; Idzorek, R. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 7p. (CONF-8710102—1). NTIS, PC A02. File Number DE87011778.

From 3. mine ventilation symposium; University Park, PA, USA (12 Oct 1987).

A numerical procedure to model flow networks using a node-based approach is discussed, and the analysis encompasses both steady-state and transient solutions. A family of computer codes has been developed using the node-based approach. This technique is illustrated by applying two of the computer codes to mine ventilation networks.

43775 (N—87-23341, pp 3) **1984 Mauna Loa eruption and planetary geolgoy.** Moore, H.J. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

In planetary geology, lava flows on the Moon and Mars are commonly treated as relatively simple systems. Some of the complexities of actual lava flows are illustrated using the main flow system of the 1984 Mauna Loa eruption. The outline, brief narrative, and results given are based on a number of sources. The implications of the results to planetary geology are clear. Volume flow rates during an eruption depend, in part, on the volatile content of the lava. These differ from the volume flow rates calculated from post eruption flow dimensions and the duration of the eruption and from those using models that assume a constant density. Mass flow rates might be more appropriate because the masses of volatiles in lavas are usually small, but variable and sometimes unknown densities impose severe restrictions on mass estimates.

43776 (N—87-23341, pp 3) **Calculated viscosity-distance dependence for some actively flowing lavas.** Pieri, D. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

The importance of viscosity as a gauge of the various energy and momentum dissipation regimes of lava flows has been realized for a long time. Nevertheless, despite its central role in lava dynamics and kinematics, it remains among the most difficult of flow physical properties to measure in situ during an eruption. Attempts at reconstructing the actual emplacement viscosities of lava flows from their solidified topographic form are difficult. Where data are available on the position of an advancing flow front as a function of time, it is possible to calculate the effective viscosity of the front as a function of distance from the vent, under the assumptions of a steady state regime. As an application and test of an equation given, relevant parameters from five recent flows on Mauna Loa and Kilauea were utilized to infer the dynamic structure of their aggregate flow front viscosity as they advanced, up to cessation. The observed form of the viscosity-distance relation for the five active Hawaiian flows examined appears to be exponential, with a rapid increase just before the flows stopped as one would expect.

43777 (N—87-23341, pp 3) **Toward a model for leveed lava flows.** Baloga, S. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

Many lava flows have two distinct volumetric components during emplacement. First, there is a component actively flowing in accordance with Newtonian or other constitutive relations. Second, there may be an inactive, stationary component that is no longer participating in the forward movement of the flow. Such passive components may take the form of flow-confining levees, solidified lateral margins, overspilling, plating, small ponds and sidestreams, or a lava tube. To describe the conservation of flow volume for the active component, governing equations are given and discussed.

43778 **(PB—87-201505/XAB) Laboratory analyses of corona discharges.** Vann Bush, P.; Snyder, T.R. (Southern Research Inst., Birmingham, AL (USA)). 1987. 19p. NTIS, PC A02/MF A01.

Pub. in Jnl. of Electrostatics, Vol. 19, No. 1, 83-99(Jan 1987).

The paper discusses an experimental research program to characterize corona generation from different electrode geometries in a range of conditions comparable to those found in electrostatic precipitators (ESPs). A wire-parallel plate device and a wire-cylinder device were used to monitor the spatial distribution and temporal stability of corona discharges. Corona phenomena were observed with a sensitive video camera. Conditions that were varied in the experiments included temperature, corona electrode design, corona polarity, and method of energization. Measurements of the distributions of corona current and statistical analyses permit an assessment of the impact of corona electrode design on ESP performance. The laboratory apparatus is described, and the experimental results are summarized.

43779 **(UCRL—15926) Rayleigh-Taylor instability in compressible fluids: Final report for the period 1 October 1985-30 September 1986.** Sturtevant, B. (Lawrence Livermore National Lab., CA (USA); California Inst. of Tech., Pasadena (USA). Graduate Aeronautical Labs.). 7 Oct 1986. Contract W-7405-ENG-48. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013494.

The purpose of this research program is to investigate fluid dynamic instabilities and mixing initiated by the interaction of shock waves with interfaces between light and heavy gases. In particular, the nonlinear stage of shock-initiated Rayleigh-Taylor insta-

bility (also known as the Richtmeyer-Meshkov instability), the secondary instabilities (e.g., the Kelvin-Helmholtz instability) arising therefrom and the resulting mixing of the two gases are of interest. This report describes activities during the performance period 1 October 1985 to 30 September 1986.

4205 Materials Testing

REFER ALSO TO CITATION(S) 43202, 43252, 43278, 43299, 43581

43780 **(MTB—175) Some new fatigue tests in high temperature water and liquid sodium environment.** Hattori, Takahiro; Yamauchi, Takayoshi; Kanasaki, Hiroshi; Kondo, Yoshiyuki; Endo, Tadayoshi. (Mitsubishi Heavy Industries Ltd., Tokyo (Japan)). Jan 1987. 9p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87753019.

To evaluate the fatigue strength of structural materials for PWR or FBR plants, fatigue test data must be obtained in an environment of simulated primary and secondary water for PWR or of high temperature liquid sodium for FBR. Generally, such tests make it necessary to prepare expensive facilities, so when large amount of fatigue data are required, it is necessary to rationalize and simplify the fatigue tests while maintaining high accuracy. At the Takasago Research Development Center, efforts to rationalize facilities and maintain accuracy in fatigue tests have been made by developing new test methods and improving conventional techniques. This paper introduces a new method of low cycle fatigue test in high temperature water, techniques for automatic measurement of crack initiation and propagation in high temperature water environment and a multiple type fatigue testing machine for high temperature liquid sodium.

43781 (N—87-22766, pp vp) **Nonisothermal elasto-viscoplastic response of shell-type structures.** Simitses, G.J.; Carlson, R.L.; Riff, R. 1987. NTIS, PC A10/MF A01. (CONF-8705148—; NASA-CP—2471; E—3512; NAS—1.55:2471).

From NASA conference on structural integrity and durability of reusable space propulsion systems; Cleveland, OH, USA (11 May 1987).

A mathematical model and solution methodologies for analyzing structural response of thin, metallic shell-type structures under large transient, cyclic or static thermomechanical loads is discussed. Among the system responses, which are associated with these load conditions, are thermal buckling and creep buckling. Thus, geometric as well as material-type nonlinearities (of high order) can be anticipated and have been considered in the development of the mathematical model. Furthermore, this was accommodated in the solution procedures. A complete true ab-inito rate theory of kinematics and kinetics for continuum and curved thin structures, without any restriction on the magnitude of the strains or the deformation, was formulated. The time dependence and large strain behavior are incorporated through the introduction of the time rates of the metric and curvature in two coordinate systems, a fixed (spatial) one and a convected (material) coordinate system. The relations between the time derivative and the covariant derivatives (gradients) have been developed for curved space and motion, so that the velocity components supply the connection between the equations of motion and the time rate of change of the metric and curvature tensors.

43782 **(SAND—87-1319C) High precision ultrasonic scanning system and SAFT-UT [synthetic aperture technique] development.** Shurtleff, W.W. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1987. Contract AC04-76DP00789. 12p. (CONF-8706179—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010038.

From JOWOG 39 NDE SUBWOG meeting; Aldermaston, UK (1 Jun 1987).

The NDT divisions at SNLA are continually striving to anticipate customer requests by adding advanced test facilities. This paper describes a new ultrasonic testing system being developed in Albuquerque to provide precise scanning of smaller test objects. There are two major subsystems that make-up the ultrasonic testing system, a high precision scanner/digitizer and a real-time processing system which automates the synthetic aperture focusing technique. These subsystems are described in the following sections.

43783 **(UCID—21131) Quantitative film analysis, Version 1.5.** Brase, J.M.; Martz, H.E. (Lawrence Livermore National Lab., CA (USA)). 28 Jan 1987. Contract W-7405-ENG-48. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014279.

A method for quantitative radiographic film analysis has been developed in the NDE section at LLNL. This method assumes that a polychromatic x-ray source can be represented by an effective energy when the beam is prefiltered. This report describes the theoretical background of the technique used and we describe the use of computer-based tools which implement this technique.

43784 **(UCRL—96376) Model-based ultrasonic tomography.** Azevedo, S.G.; Fitch, J.P.; Thomas, G.H. (Lawrence Livermore National Lab., CA (USA); Sandia National Labs., Livermore, CA (USA)). 1987. Contract AC04-76DR00789;W-7405-ENG-48. 9p. (CONF-870691—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013786.

From Review of progress in quantitative NDE; Williamsburg, VA, USA (21 Jun 1987).

A standard tank for routine ultrasonic non-destructive testing has been used for collecting tomographic data. Side-wall reflections of the tank prevent the use of continuous parallel waves characteristic of most ultrasonic tomography systems. Instead, the part is insonified with unfocused chirped pulses and the transmitted A-scan is captured by a moving point-receiver. A computer-controlled rotating stage eliminates operator interaction during the collection of projections. The reconstruction process is a modified filtered backpropagation technique making use of the part structure. This is possible because the parts are often numerically milled with accurate dimensions available from the fabrication data base. In this paper, the imaging model emphasizes restrictions based on the expected scattering associated with the diffracting illumination and performance improvements by incorporating the a priori part information.

4208 Electronic Circuits And Devices

REFER ALSO TO CITATION(S) 43168, 43235, 43629, 43634

43785 **(BDX—613-3805) Voice entry of hybrid microcircuit inspection data.** Hacker, M.W. (Allied Corp., Kansas City, MO (USA). Bendix Kansas City Div.). Jul 1987. Contract AC04-76DP00613. 10p. (CONF-8708108—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012988.

From Conference on voice recognition applications in manufacturing; Schaumburg, IL, USA (25 Aug 1987).

Because every major manufacturer is trying to keep a competitive edge, millions of dollars are being spent on factory automation. However, automation alone does not provide the total answer. If processes are not characterized and then controlled as an integral part of factory automation, a less than optimum process with low yields resulting in either high rework costs or larger scrap piles will occur. Many good articles have been written on how to setup control charts to monitor processes, however, the key to a control chart working properly is to have accurate and timely data. Voice data entry provides the means of getting accurate and timely data.

43786 **(CONF-870656—32) New concepts for high current self-sustained diffuse discharge closing switches.** Hunter, S.R.; Christophorou, L.G.; Carter, J.G.; Datskos, P.G. (Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville (USA). Dept. of Physics). 1987. Contract AC05-84OR21400. 9p. NTIS, PC A02. File Number DE87011678.

From 6. Institute of Electrical and Electronic Engineers pulsed power conference; Arlington, VA, USA (29 Jun 1987).

Developed are new switching concepts that potentially can increase the efficiency and stability of high current diffuse discharges when used in repetitive fast closing switch applications. The primary advantage of diffuse discharges over spark gap closing switches is that a diffuse discharge has a much faster recovery time ($<10^{-4}$ s) compared to an arc discharge ($>10^{-3}$ s), enabling the switch to be operated at high repetition rates. The major disadvantage of diffuse discharges are the high sustaining voltage across the discharge and the resultant high switch impedance (several ohms)

compared with spark gaps ($<<1\Omega$). Also explored is a new diffuse glow discharge operating scheme with a new type of gas mixture whose components collectively possess an ionization coefficient, α/N, at low E/N which is larger than the attachment coefficient, eta/N, over a given, E/N range, while at higher E/N values, eta/N is larger than α/N over another range of E/N values.

43787 **(LA-UR—87-2079) Expectations for the Laguna foil implosion experiments.** Greene, A.; Brownell, J.; Caird, R.; Goforth, J.; Price, R.; Trainor, J. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 15p. (CONF-870656—26). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011766.

From 6. Institute of Electrical and Electronic Engineers pulsed power conference; Arlington, VA, USA (29 Jun 1987).

Building on the results achieved in the Pioneer shot series, the Los Alamos Trailmaster project is embarking on the Laguna foil implosion experiments. In this series a Mark-IX helical generator will be coupled to an explosively formed fuse opening switch, a surface-tracking closing switch, and a vacuum power flow and load chamber. In this paper the system design will be discussed and results from zero-, one-, and two-dimensional MHD simulations will be presented. It is anticipated that the generator will provide more than 10 MA of which ~5.5 MA will be switched to the 5-cm-radius, 2-cm-high, 250-nm-thick aluminum foil load. This should give rise to a 1 μs implosion with more than 100 kJ of kinetic energy.

43788 **(LA-UR—87-2094) Characterization of surface discharge switches and high performance applications.** Reinovsky, R.E.; Goforth, J.H.; Greene, A.E.; Graham, J. (Los Alamos National Lab., NM (USA); Maxwell Labs., Inc., San Diego, CA (USA)). 1987. Contract W-7405-ENG-36. 9p. (CONF-870656—25). NTIS, PC A02. File Number DE87011763.

From 6. Institute of Electrical and Electronic Engineers pulsed power conference; Arlington, VA, USA (29 Jun 1987).

Results of experiments which were conducted to characterize the performance of a surface discharge as a high-performance, self-closing isolation switch for high energy applications are described. These experiments, conducted under both dc and pulsed conditions, lead to a model of switch operation which enables the design of such switches for multi-megajoule operation. The paper describes the successful implementation of a surface switch as an operational component in a multi-megampere pulse-power system.

43789 **(LA-UR—87-2192) Switching devices used in the Lethality Test System.** Parsons, W.M.; Ford, R.D.; Wildi, P.; Chowdhuri, P. (Los Alamos National Lab., NM (USA); Naval Research Lab., Washington, DC (USA); Texas Univ., Austin (USA); Tennessee Technological Univ., Cookeville (USA)). 1987. Contract W-7405-ENG-36. 6p. (CONF-870656—34). NTIS, PC A02. File Number DE87011734.

From 6. Institute of Electrical and Electronic Engineers pulsed power conference; Arlington, VA, USA (29 Jun 1987).

The Lethality Test System (LTS) is an experiment which will utilize a light gas gun-railgun combination to accelerate projectiles for impact studies. The power supply for the railgun consists of an 80 MJ (kinetic) generator-flywheel array used to charge the primary windings of three cryogenic pulse transformers. The secondary windings of these transformers will supply up to 50 MJ of electrical energy to the railgun. A number of special switching devices will be required to cause energy transfer and compression. This paper describes the design and testing of these switching devices.

43790 **(SAND—86-0713) Aluminum doping studies on high field ZnO varistors.** Kimball, K.M.; Doughty, D.H. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1987. Contract AC04-76DP00789. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014270.

We have investigated the effect of Al doping on the physical and electronic properties of high field ZnO varistors. For this study, varistors containing 98.94 m/o ZnO, 0.25 m/o CoO, 0.25 m/o MnO, 0.56 m/o Bi_2O_3 and 0 to 200 ppM Al were prepared from powders obtained from solution precipitation techniques. Because of the amphoteric nature of aluminum oxides, precise control of pH and metal concentrations was necessary to assure complete incorporation of dopants. We observed inhibition of grain growth during sintering of varistor pellets at aluminum concentrations of 50 ppM and above. The measured electrical properties show increased switching fields and increased nonlinearity coefficients for Al doping levels of 50 to 200 ppM.

43791 **(SAND—87-0017C) Toward pulsed power uses for photoconductive semiconductor switches: Closing switches.** Loubriel, G.M.; O'Malley, M.W.; Zutavern, F.J. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 4p. (CONF-870656—38). NTIS, PC A02. File Number DE87012020.

From 6. Institute of Electrical and Electronic Engineers pulsed power conference; Arlington, VA, USA (29 Jun 1987).

Recent results on Photoconductive Semiconductor Switches (PCSS) are presented. For Si and GaAs switches surface flashover, contact degradation, and current limitations are addressed. For Si samples have been obtained that, without being triggered, withstand fields of up to 85 kV/cm produced by an ~2-μs wide voltage pulse. The 1-inch diameter, Si samples ("gap length" of 1.5 cm) have been switched at 36 kV/cm (≃54 kV) into an ~30-Ω load with a current of 703 A. For GaAs, most samples can withstand, without being triggered, 100 kV/cm. At low electric fields the GaAs samples behave as switches that close during the laser pulse and then open in nanoseconds. At high voltages GaAs does not open. In this mode, called lock-on, up to 42.7 kV/cm (64.1 kV) has been switched. The lock-on mode can be triggered with small laser powers. Plans are being made to use large arrays of GaAs samples to switch 1 MV and 156 kA.

43792 **(SAND—87-0100C) Scaling relations for the Rimfire multi-state gas switch.** Turman, B.N.; Humphreys, D.R. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 8p. (CONF-870656—27). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011856.

From 6. Institute of Electrical and Electronic Engineers pulsed power conference; Arlington, VA, USA (29 Jun 1987).

Analysis of several Rimfire-type gas switch data sets between 2.4 and 5 MV allows us to develop scaling relationships for the switching mechanisms of multi-stage gas-insulated switches. Laser-triggering has been emphasized in this study. The major conclusions of this study were The maximum E-field that can be tolerated without prefire is derived from self-breakdown Weibull statistics. This maximum field, for a 0.003 probability of prefire per switch, is $E/P < 82 - 3.5\ P$ for $P < 4$ bars. The maximum allowable insulator field is E/P/sub ins/ $<$ 25 kV/cm-bar. At this level, the flashover probability is expected to be about 0.003. The standard deviation of trigger delay time (jitter) increases rapidly for fields lower than 46 kV/cm-bar at a minimum laser energy of approximately 10 mJ per switch. The voltage across the trigger section should be at least 20% of the total voltage.

43793 **(SAND—87-0580) Analysis of the electromagnetic performance characteristics of stripline transformers.** Kotulski, J.D. (Sandia National Labs., Albuquerque, NM (USA)). Jul 1987. Contract AC04-76DP00789. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012515.

The electromagnetic parameters (self-inductances, coupling factor, and resistance) of circular stripline transformers are calculated using the canonical problem of a current loop. A 10-to-1-turn transformer is analyzed ad the results are compared to measurements. A 1-to-1 transformer is also considered, and the effect of geometry on the parameters is determined.

43794 **(SAND—87-0953C) Speed of response of catalytic gate MIS gas sensors on silicon.** Hughes, R.C.; Ricco, A.J.; Rye, R.R. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 11p. (CONF-871027—17). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009715.

From 172. meeting of the Electrochemical Society; Honolulu, HI, USA (18 Oct 1987).

Silicon diodes employing Pd as a contact (gate) on top of a thin intervening SiO_2 layer make excellent detectors for molecular hydrogen. The response to hydrogen results from the population of Pd/SiO_2 interfacial traps by atomic H. Response time is of the order of minutes at 30°C for 100 ppM of H_2, though the speed of response can be increased by orders of magnitude by sputter cleaning the Pd in ultrahigh vacuum (uhv). Two aspects of the problem of contamination by exposure to the atmosphere are reported on: (1) the time dependence of the loss of activity of a cleaned diode after removal from uhv, and (2) the response characteristics of a contaminated diode. The response speed of clean diodes decreases by a factor of 15 within days. For diodes which have not been cleaned, comparison is made between the rates of filling and emptying of the interfacial traps, as measured by the diode signal, with the rate of filling and emptying of the bulk, as measured by the resistance of the Pd. It is concluded that, for diodes with a contaminated Pd surface, the bulk and interface are in equilibrium throughout the filling and emptying processes, with adsorption and desorption being the rate-limiting steps.

43795 **(SAND—87-1024C) A video authentication technique.** Johnson, C.S. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 4p. (CONF-870713—25). NTIS, PC A02. File Number DE87012019.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

Unattended video surveillance systems are particularly vulnerable to the substitution of false video images into the cable that connects the camera to the video recorder. New technology has made it practical to insert a solid state video memory into the video cable, freeze a video image from the camera, and hold this image as long as desired. Various techniques, such as long supervision and sync detection, have been used to detect video cable tampering. The video authentication technique described in this paper uses the actual video image from the camera as the basis for detecting any image substitution made during the transmission of the video image to the recorder. The technique, designed for unattended video systems, can be used for any video transmission system where a two-way digital data link can be established. The technique uses similar microprocessor circuitry at the video camera and at the video recorder to select sample points in the video image for comparison. The gray scale value of these points is compared at the recorder controller and if the values agree within limits, the image is authenticated. If a significantly different image was substituted, the comparison would fail at a number of points and the video image would not be authenticated. The video authentication system can run as a stand-alone system or at the request of another system.

43796 **(SAND—87-1367C) Recent developments in opening photoconductive semiconductor switches.** Zutavern, F.J.; Loubriel, G.M.; O'Malley, M.W. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 9p. (CONF-870656—35). NTIS, PC A02. File Number DE87012130.

From 6. Institute of Electrical and Electronic Engineers pulsed power conference; Arlington, VA, USA (29 Jun 1987).

While developing high power photoconductive semiconductor switches (PCSS) for opening and closing (toggling) applications, we have recorded extremely fast opening times and what appears to be the onset of non-destructive electron avalanching. Using 1- and 2-inch diameter wafers of GaAs, Cr:GaAs, and Au:Si, we have switched a 50-ohm, 80-ns transmission line at voltages up to 65 kV. In the dark, the GaAs switches will stand-off dc fields up to 30 kV/cm in SF_6. Upon optical triggering, the behavior depends on the average electric field. Below 4 kV/cm (8 kV/cm doped) they open with a 20-ns (< 3 ns doped) exponential recovery time. When the light is removed above these fields, the switches lock on, conducting whatever current the circuit will supply and stabilizing to 4 kV/cm (8 kV/cm doped) across the switch. Additionally, reliable triggering of a 2-inch GaAs switch (3.4-cm gap) in this "locking on" mode was achieved with a 70-μJ, 532-nm, 10-ns light pulse (less than 1/100th the light required to trigger the switch at low voltages). The Au:Si samples did not lock-on. They opened with an exponential recovery time of 20 to 40 ns at fields up to 35 kV/cm. Undoped silicon samples show recovery times of several hundred microseconds.

43797 **Pulse-excited, auto-zeroing multiple channel data transmission system.** Fashing, G.E. (to Dept. of Energy, Washington, DC). US Patent 4,680,585. 14 Jul 1987. Filed date 22 Feb 1985. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

This patent describes a multiple channel data transmission system, comprising: data channels; each channel including a transducer for generating an output signal proportional to a variable to be measured in response to the application of a transducer excitation pulse; a transducer amplifier means for amplifying the output of the transducer in response to the application of an amplifier excitation pulse; a sample-and-hold circuit means for sampling and holding the output level of the amplifier means in response to a sample-and-hold strobe pulse applied; and an auto zeroing means for nulling the output of the amplifier means in response to an auto zero strobe pulse applied. A control means cyclically generates at a selected cycle rate the transducer excitation pulse; the amplifier excitation pulses; sample-and-hold strobe pulses and auto zero strobe pulses so that the amplifier means is excited for a preselected period during which the auto zero strobe pulse is generated. The transducer excitation pulse and the sample-and-hold strobe pulse generates during the transducer excitation pulse so that the value stored by the sample-and-hold circuit means is updated during each cycle of the control means, producing pseudo-continuous outputs from the sample-and-hold circuit means of each of data channels. A transmitter means includes a multiplexer means for continuously sampling the pseudo-continuous outputs of each of the data channels and multiplexing the signals onto a single channel to produce a modulated signal; and a means for receiving the modulated signal.

43798 **Reactive power compensating system.** Williams, T.J.; El Sharkawi, M.A.; Venkata, S.S. (to Dept. of Energy, Washington, DC). US Patent 4,677,364. 30 Jun 1987. Filed date 4 Jan 1985. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

This patent describes a reactive power compensating system for a three phase induction machine comprising: an array of switchable capacitors connected to a power line of each phase, means for measuring the reactive power drawn; logic decision means responsive for selecting the capacitors of each array required to compensate for power drawn by the induction machine, and means responsive for switching selected capacitors of each array onto the power line associated with the array. The reactive power measuring means is comprised of means for sensing the current through a power line of only one phase. Means for converting the current sensed into a proportional voltage signal is initiated. A means is used for sampling and holding voltage for at least a half cycle when the voltage of the one phase crosses zero.

4209 Waste Processing Plants And Equipment

REFER ALSO TO CITATION(S) 43143

43799 **(PB—87-201497/XAB) Evaluation of combustion processes for destruction of liquid organic wastes in a sulfuric-acid regeneration furnace.** Ouchida, P. (California State Air Resources Board, Sacramento (USA). Stationary Source Div.). Nov 1985. 102p. (ARB/SS—87-03). NTIS, PC A06/MF A01.

The test mechanism, efforts, and results associated with incineration of liquid organic wastes in a sulfuric-acid regeneration furnace are described in the report. Industrial wastes representing those to be ultimately processed, if the system is acceptable, were not available or could not be clearly characterized as to chemical nature. A synthetic, or surrogate, mix was therefore burned with the alkylation acid to allow an analysis of potential emissions to be made. The tests conducted were broken down into three categories based on furnace operating conditions: base line (spent alkylation acid, only, being fed into the furnace under typical operating conditions); normal (spent alkylation acid spiked with the synthetic mix fed into the furnace under typical operating conditions) and; low O_2 (spent alkylation acid spiked with the synthetic mix fed into the furnace operating at nonstandard, or failure mode, conditions of low O_2 and low temperature). These test conditions helped estab-

lished an operating envelope within which efficient combustion could be assured.

4210 Combustion Systems

REFER ALSO TO CITATION(S) 42963, 42978, 43514, 43515, 43551, 43769

43800 (N—87-22245) **Development of gas-to-gas lift pad dynamic seals, volumes 1 and 2. Final report.** Pope, A.N.; Pugh, D.W. (General Electric Co., Cincinnati, OH (USA)). May 1987. 189p. (NASA-CR—179486; NAS—1.26:179486; R—87-AEB432). NTIS, PC A09/MF A01.

Dynamic tests were performed on self acting (hydrodynamic) carbon face rotary shaft seals to assess their potential, relative to presently used labyrinth seals, for improving performance of aircraft gas turbine engines by reducing air leakage flow rate at compressor end seal locations. Three self acting bearing configurations, designed to supply load support at the interface of the stationary carbon seal and rotating seal race, were tested. Two configurations, the shrouded taper and shrouded flat step, were incorporated on the face of the stationary carbon seal element. The third configuration, inward pumping spiral grooves, was incorporated on the hard faced surface of the rotating seal race. Test results demonstrated seal leakage air flow rates from 75 to 95% lower that can be achieved with best state-of-the-art labyrinth designs and led to identification of the need for a more geometrically stable seal design configuration which is presently being manufactured for subsequent test evaluation.

43801 (N—87-22766, pp vp) **Experimental and theoretical studies of time-averaged and time resolved rotor heat transfer.** Dunn, M.G.; Rae, W.J.; Rigby, D.L. 1987. NTIS, PC A10/MF A01. (CONF-8705148—; NASA-CP—2471; E—3512; NAS—1.55:2471).

From NASA conference on structural integrity and durability of reusable space propulsion systems; Cleveland, OH, USA (11 May 1987).

Efforts in support of the Space Shuttle Main Engine (SSME) structural durability program have concentrated on obtaining detailed time-averaged and time-resolved (or phase-locked) measurements on a full-scale rotating turbine both with and without cold gas injection and on theoretical studies designed to improve the prediction capability for these turbine flows. The experimental efforts have concentrated on use of the Garrett TFE 731-2 hp turbine. However, it has been possible to apply the theoretical efforts to predicting heat-flux distributions obtained for two additional turbines - i.e., (1) the Garrett low aspect ratio turbine (LART) and (2) the Teledyne 702 turbine. The experimental technique is the short duration, shock-tunnel approach, in which fast-response, thin-film resistance thermometers are used to measure surface temperature histories at prescribed locations on the turbine component parts. Heat-flux values are then inferred from the temperature histories by using standard data reduction procedures. The turbine being used is the Garrett TFE 731-2 hp stage, and both the nozzle guide vanes and the rotor blades are heavily instrumented with thin-film heat-flux gauges. Depending on how the data from a particular heat-flux gauge are recorded, one can get either time-resolved (or phase-locked) or time-averaged results. Both types of data are illustrated.

43802 (N—87-22766, pp vp) **Analytical and experimental studies of flow-induced vibration of SSME components.** Chen, S.S.; Jendrzejczyk, J.A.; Wambsganss, M.W. 1987. NTIS, PC A10/MF A01. (CONF-8705148—; NASA-CP—2471; E—3512; NAS—1.55:2471).

From NASA conference on structural integrity and durability of reusable space propulsion systems; Cleveland, OH, USA (11 May 1987).

Components of the Space Shuttle Main Engines (SSMEs) are subjected to a severe environment that includes high-temperature, high-velocity flows. Such flows represent a source of energy that can induce and sustain large-amplitude vibratory stresses and/or result in fluidelastic instabilities. Three components are already known to have experienced failures in evaluation tests as a result of flow-induced structural motion. These components include the liquid-oxygen (LOX) posts, the fuel turbine bellows shield, and the internal inlet tee splitter vane. Researchers considered the dynamic behavior of each of these components with varying degrees of effort: (1) a theoretical and experimental study of LOX post vibration excited by a fluid flow; (2) an assessment of the internal inlet tee splitter vane vibration (referred to as the 4000-Hz vibration problem); and (3) a preliminary consideration of the bellows shield problem. Efforts to resolve flow-induced vibration problems associated with the SSMEs are summarized.

43803 (N—87-22766, pp vp) **Progress on thin-film sensors for space propulsion technology.** Kim, W.S. 1987. NTIS, PC A10/MF A01. (CONF-8705148—; NASA-CP—2471; E—3512; NAS—1.55:2471).

From NASA conference on structural integrity and durability of reusable space propulsion systems; Cleveland, OH, USA (11 May 1987).

The objective is to develop thin-film thermocouples for Space Shuttle Main Engine (SSME) components. Thin-film thermocouples have been developed for aircraft gas turbine engines and are in use for temperature measurement on turbine blades to 1800 F. The technology established for aircraft gas turbine engines will be adapted to the materials and environment encountered in the SSME. Specific goals are to expand the existing in-house thin-film sensor technology and to test the survivability and durability of thin-film sensors in the SSME environment.

43804 (N—87-22766, pp vp) **Probabilistic structural analysis to evaluate the structural durability of SSME critical components.** Chamis, C.C. 1987. NTIS, PC A10/MF A01. (CONF-8705148—; NASA-CP—2471; E—3512; NAS—1.55:2471).

From NASA conference on structural integrity and durability of reusable space propulsion systems; Cleveland, OH, USA (11 May 1987).

NASA Lewis Research Center is currently developing probabilistic structural analysis methods for select Space Shuttle Main Engine (SSME) structural components. Briefly, the deterministic, three-dimensional, inelastic analysis methodology developed under the Hot Section Technology (HOST) and R and T Base Programs is being augmented to accommodate the complex probabilistic loading spectra, the thermoviscoplastic material behavior, and the material degradation associated with the environment of space propulsion system structural components representative of the SSME such as turbine blades, transfer ducts, and liquid-oxygen posts. The development of probabilistic structural analysis methodology consists of the following program elements: (1) composite load spectra; (2) probabilistic structural analysis methods; (3) probabilistic finite element theory - new variational principles; and (4) probabilistic structural analysis application. In addition, the program includes deterministic analysis elements: (1) development of structural tailoring computer codes (SSME/STAEBL); (2) development of dynamic creep buckling/ratcheting theory; (3) evaluation of the dynamic characteristics of single-crystal SSME blades; (4) development of SSME blade damper technology; and (5) development of integrated boundary elements for hotfluid structure interaction.

43805 (N—87-22766, pp vp) **Probabilistic structural analysis verification studies.** Rajagopal, K.R. 1987. NTIS, PC A10/MF A01. (CONF-8705148—; NASA-CP—2471; E—3512; NAS—1.55:2471).

From NASA conference on structural integrity and durability of reusable space propulsion systems; Cleveland, OH, USA (11 May 1987).

The basic objective of this verification effort is to apply probabilistic structural analysis methods developed and implemented in the Numerical Evaluation of Stochastic Structures Under Stress (NESSUS) code to typical space propulsion components. The chosen typical components are turbine blade, high pressure duct, Lox post, and transfer tube liners. Since analysis options of increasing levels of sophistication are implemented in NESSUS incrementally, the verification efforts are also tailored to have increasing levels of sophistication during the progression of the contract. The current released version of the code is limited to linear structural analysis.

43806 (N—87-22766, pp vp) **Structural tailoring using the SSME/STAEBL code.** Rubinstein, R. 1987. NTIS, PC A10/MF A01. (CONF-8705148—; NASA-CP—2471; E—3512; NAS—1.55:2471).

From NASA conference on structural integrity and durability of reusable space propulsion systems; Cleveland, OH, USA (11 May 1987).

Space Shuttle Main Engine/Structural Tailoring of Engine Blades (SSME/STAEBL) was developed by systematically modifying and enhancing the STAEBL code developed by Pratt and Whitney under contract to NASA Lewis Research Center. STAEBL was designed for application to gas turbine blade design. Typical design variables include blade thickness distribution and root chord. Typical constraints include resonance margins, root stress, and root to chord ratios. In this program, the blade is loaded by centrifugal forces only. Additions and modifications of STAEBL included in SSME/STAEBL include (1) thermal stress analysis; (2) gas dynamic (pressure) loads; (3) temperature dependent material and thermal properties; (4) forced vibrations; (5) tip displacement constraints; (6) single crystal material analysis; (7) blade cross section stacking offsets; and (8) direct time integration algorithm for transient dynamic response. Capabilities are also included which permit data transfer from finite element models and stand-alone analysis.

43807 (N—87-22959) **Laser anemometry techniques for turbine applications.** Wernet, M.P.; Oberle, L.G. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Jun 1987. 17p. (CONF-870505—5; NASA-TM—88953; E—3369; NAS—1.15:88953). NTIS, PC A02/MF A01.

From 32. international gas turbine conference and exhibition; Anaheim, CA, USA (31 May 1987).

Laser anemometry offers a nonintrusive means for obtaining flow field information. Current research at NASA Lewis Research Center is focused on instrumenting a warm turbine facility with a laser anemometer system. In an effort to determine the laser anemometer system best qualified for the warm turbine environment, the performance of a conventional laser fringe anemometer and a two spot time of flight system were compared with a new, modified time of flight system, called a Four Spot laser anemometer. The comparison measurements were made in highly turbulent flows near walls. The Four Spot anemometer uses elliptical spots to increase the flow acceptance angle to be comparable to that of a Laser Fringe Anemometer. Also, the Four Spot uses an optical code that vastly simplifies the pulse detection processor. The results of the comparison measurements will exemplify which laser anemometer system is best suited to the hostile environment typically encountered in warm rotating turbomachinery.

43808 (N—87-22996) **3-D inelastic analysis methods for hot section components. Volume 1: Special finite element models. Annual status report, 14 February 1985-14 February 1986.** Nakazawa, S. (Pratt and Whitney Aircraft, East Hartford, CT (USA)). Mar 1987. 102p. (NASA-CR—179494; NAS—1.26:179494; PWA—5940-46-VOL-1; ASR—3). NTIS, PC A06/MF A01.

This annual status report presents the results of work performed during the third year of the 3-D Inelastic Analysis Methods for Hot Section Components program (NASA Contract NAS3-23697). The objective of the program is to produce a series of new computer codes that permit more accurate and efficient three-dimensional analysis of selected hot section components, i.e., combustor liners, turbine blades, and turbine vanes. The computer codes embody a progression of mathematical models and are streamlined to take advantage of geometrical features, loading conditions, and forms of material response that distinguish each group of selected components. This report is presented in two volumes. Volume 1 describes effort performed under Task 4B, Special Finite Element Special Function Models, while Volume 2 concentrates on Task 4C, Advanced Special Functions Models.

43809 (PB—87-196788/XAB) **Low NOx, high-efficiency multistaged burner: fuel-oil results.** Mulholland, J.A.; Srivastava, R.K. (Acurex Corp., Research Triangle Park, NC (USA)). May 1987. 30p. NTIS, PC A03/MF A01.

This paper discusses the fuel-oil portion of an evaluation, utilizing a multistaged combustion burner designed for in-furnace NOx control and high combustion efficiency, for high nitrogen-content fuel and waste-incineration application in a 0.6-MW package boiler simulator. A low-NOx precombustion chamber burner was reduced in size by about a factor of two (from 600 to 250 ms first-stage residence time) and coupled with (1) air staging, resulting in a three-stage configuration, and (2) natural gas fuel staging, yielding up to four stoichiometric zones. Natural gas, doped with ammonia to yield a 5.8% fuel nitrogen content, and distillate fuel oil, doped with pyridine to yield a 2% fuel nitrogen content, were used to simulate high nitrogen content fuel/waste mixtures. The multistaged burner reduced NO emissions by 85% from emission levels from a conventional unstaged burner mounted on a commercial package boiler. A minimum NO emission level of 110 ppm was achieved in the fuel-oil tests, from a level of 765 ppm for conventional firing.

4220 Underground Engineering

REFER ALSO TO CITATION(S) 43774

43810 (CONF-8512135—) **Advances in technology for the construction of deep-underground facilities.** (National Research Council, Washington, DC (USA). Commission on Engineering and Technical Systems). 1987. Contract AI01-86RW00091. 62p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87009067.

From Advances in technology for the construction of deep-underground facilities conference; Reston, VA, USA (12 Dec 1985).

Information is presented concerning the design considerations, construction issues, and excavation equipment and systems involved with the building of facilities deep underground. (JDB)

4230 Marine Engineering

REFER ALSO TO CITATION(S) 43000

43811 (AUC-IBT—8620) **Reliability analysis of tubular joints in offshore structures. Structural reliability theory, Paper No. 23.** Thoft-Christensen, P.; Soerensen, J.D. (Aalborg Universitetscenter (Denmark). Inst. for Bygningsteknik). Dec 1986. 16p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87752861.

Reliability analysis of single tubular joints and offsore platforms with tubular joints is presented. The failure modes considered are yielding, punching, buckling and fatigue failure. Element reliability as well as systems reliability approach are used and illustrated by several examples. Finally, optimal design of tubular joints with reliability constraints is discussed and illustrated by an example. 12 refs.

43812 (IFP—32-004) **Modelling soil behavior under cyclic sollicitation.** Lassoudiere, F. (Institut Francais du Petrole (IFP), 92 - Reuil-Malmaison; Ecole Centrale des Arts et Manufactures, 92 - Chatenay-Malabry (France)). Apr 1984. 159p. (In French). NTIS (US Sales Only), PC A08/MF A01. File Number DE87753163.

The foundations of offshore platforms are subjected to complex cyclic stresses due to swell. Dimensioning of piles requires new calculation methods. The finite element method is well suited to solve these problems if the evolution of mechanical properties of the soil, undergoing a great number of loading cycles, are taken into account and if parameters can be determined by soil tests. The behavior of soils under cyclic sollicitation is studied in this work by an elastoplastic formulation and by the introduction of kinematic hardening taking into account continuous and discontinuous evolution parameters for effects of loading cycles in the range of about 100, allowing the calculation of an underwater foundation (pile or gravity structure) under few hundreds cycles corresponding to exceptional sollicitations (decennial or centennial storm).

4240 Pollution Control Equipment

REFER ALSO TO CITATION(S) 44019

43813 (PB—87-195368/XAB) Advanced electrostatic stimulation of fabric filtration: performance and economics. Viner, A.S.; Greiner, G.P.; Hovis, L.S. (Research Triangle Inst., Research Triangle Park, NC (USA)). May 1987. 25p. NTIS, PC A02/MF A01.

This paper discusses the performance and economics of advanced electrostatic stimulation of fabric filtration (AESFF), in which a high-voltage electrode is placed coaxially inside a filter bag to establish an electric field between the electrode and the bag surface. The electric field alters the dust-deposition pattern in the bag, yielding a much lower pressure drop than that in a conventional bag. Pilot-plant results show that AESFF bags can operate with a rate of pressure loss that is 70% below that for conventional bags. An economic analysis evaluated the capital, operating, and maintenance costs for electric utility plants ranging from 200 to 1000 MW. For AESFF baghouses, the capital cost was found to be 25 to 48% below that of a conventional baghouse.

43 PARTICLE ACCELERATORS

43814 (AD-A—181085/2/XAB) Modeling of transient effects in railgun plasma armatures. Final report, January-September 1986. Batteh, J.H.; Rolader, G.E. (Science Applications International Corp., Marietta, GA (USA)). Mar 1987. 77p. NTIS, PC A05/MF A01.

Two different one-dimensional, time-dependent models are developed to study transient phenomena in railgun plasma armatures. The first model consists of the equations for conservation of mass and momentum, and the magnetic diffusion equation for an isothermal plasma. The second, more general model eliminates the assumption of an isothermal arc, and allows for the generation and transfer of heat within the armature. This requires that the conservation equations be supplemented by an energy equation. Validation of this isothermal model is achieved by comparing the long-time behavior of numerical solutions to known analytic solutions. Evolution of a plasma armature from a stationary steady-state was studied to provide an estimate for the relaxation time. Simulation of the initiation of a plasma armature from an exploding foil in contact with the projectile with the isothermal model indicates that the initiation process strongly influences the dynamics of the arc/projectile system at early times. The more-general armature model is applied to the study of the transient processes which occur when an armature collides with a projectile. Preliminary calculations indicate the utility of the model in helping to understand transient phenomena. Several possible techniques for reducing the computation time of the general model are identified. The implications of these results on the performance of railguns, as well as plans for future analyses, are discussed.

43815 (GANIL—1972-1982) Ganil: design and realization. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). 1986. 225p. (In French and English). NTIS (US Sales Only), PC A10/MF A01. File Number DE87752343.

Most typical papers on the Ganil construction have been gathered in this book to somehow notice the success of its realization. Papers concern the accelerator and beam line, excluding experimental areas.

4301 Design, Development, And Operation

REFER ALSO TO CITATION(S) 44470, 44472, 44473, 44474, 44475, 44509

43816 (CONF-870302—220) Recent performance of the Intense Pulsed Neutron Source accelerator system. Potts, C.; Brumwell, F.; Rauchas, A.; Stipp, V.; Volk, G.; Donley, L. (Argonne National Lab., IL (USA)). Mar 1987. Contract W-31109-ENG-38. 4p. NTIS, PC A02. File Number DE87011497.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The Intense Pulsed Neutron Source (IPNS) accelerator system has now been in operation as part of a national user program for over five years. During that period steady progress has been made in both beam intensity and reliability. Almost 1.8 billion pulses totaling 4 x 10^{21} protons have now been delivered to the spallation neutron target. Recent weekly average currents have reached 15 μA (3.2 x 10^{12} protons per pulse, 30 pulses per second) and short-term peaks of almost 17 μA have been reached. In fact, the average current for the last two years is up 31% over the average for the first three years of operation.

43817 (DOE/ER/13585—1) Application of high power modulated intense relativistic electron beams for development of a wake field accelerator: Progress report, August 1986-May 1987. (Naval Research Lab., Washington, DC (USA)). 1987. Contract AI05-86ER13585. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012197.

43818 (LBL—23623) The LBL 1-2 GeV synchrotron radiation source. Selph, F.B. (Lawrence Berkeley Lab., CA (USA)). Jun 1987. Contract AC03-76SF00098. 42p. (CONF-870610—7). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012876.

From 5. national synchrotron radiation instrumentation conference; Madison, WI, USA (21 Jun 1987).

The design of the 1 to 2 GeV Synchrotron Radiation Source to be built at the Lawrence Berkeley Laboratory is described. The goal of this facility is to provide very high brightness photon beams in the ultraviolet and soft x-ray regions. The photon energy range to be served is from 0.5 eV to 10 keV, with the brightest beams available in the 1 eV to 1 keV interval. For time-resolved experiments, beam pulses of a few tens of picoseconds will be available. Emphasis will be on the use of undulators and wigglers to produce high quality, intense beams. Initially, four of the former and one of the latter devices will be installed, with six long straight sections left open for future installations. In addition, provision is being made for 48 beamlines from bending magnets. The storage ring is optimized for operation at 1.5 GeV, with a maximum energy of 1.9 GeV. The injection system includes a 1.5 GeV booster synchrotron for full energy injection at the nominal operating energy of the storage ring. Filling time for the maximum storage ring intensity of 400 mA is about 2 minutes, and beam lifetime will be about 6 hours. Attention has been given to the extraordinary requirements for beam stability, and to the need to independently control photon beam alignment. Typical rms beam size in insertion regions is 201 μm horizontal, and 38 μm vertical. The manner in which this design achieves very high spectral brightness from undulators and wigglers, while maintaining a modest value for the beam current, will be described. Primarily, this requires that the design of the lattice, the arrangement of bending magnets, focusing quadrupoles and straight sections, be done with this in mind.

43819 (LBL-PUB—3064) User's guide for the SSC DRAWINGS database system. Konrad, A. (Lawrence Berkeley Lab., CA (USA)). Jun 1987. Contract AC03-76SF00098. 43p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012712.

The SSC DRAWINGS database system was implemented at the request of the Mechanical Engineering Department to provide interactive management and use of SSC engineering drawings. Printed listings are easily produceable.

43820 (SAND—87-0303C) Engineering design of the Saturn accelerator. Boyes, J.D.; Cap, J.S.; Douglas, G.M.; Franklin, T.L.; Hart, J.M.; Ives, H.C.; Robischon, S.J.; Smith, B.L.; Stoppkotte, W.O.; VanDeValde, D.M. (Sandia National Labs., Albuquerque, NM (USA); Pulse Sciences, Inc., San Leandro, CA (USA)). 1987. Contract AC04-76DP00789. 4p. (CONF-870656—28). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011863.

From 6. Institute of Electrical and Electronic Engineers pulsed power conference; Arlington, VA, USA (29 Jun 1987).

The Saturn accelerator is a large flash x-ray simulator being constructed as a part of Sandia's Simulation Technology Laboratory. The performance goal of the machine is to provide x-ray expo-

sure capabilities of 5 x 10^{12} rads/s (Si) and 5 cal/g (Au) uniformly distributed over a 500 cm^2 target area. The operational goal of the machine is to provide this exposure capability reliably in a multiple-shot-a-day mode. This paper will describe the engineering designs which accomplish these goals. This project was a joint effort with Pulse Sciences Inc. personnel performing the conceptual and initial designs, and Sandia National Laboratories personnel performing the final design of the hardware, procurement, manufacturing liaison and the assembly of the machine.

43821 (SAND—87-0314C) The PTO linear induction accelerator. Lancaster, K.T.; Stinnett, R.W.; Buttram, M.T.; Clark, R.S.; Ginn, J.W.; Poukey, J.W. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-870656—12). NTIS, PC A02/MF A01. File Number DE87011723.

From 6. Institute of Electrical and Electronic Engineers pulsed power conference; Arlington, VA, USA (29 Jun 1987).

The PTO accelerator is a test-bed for the study of issues involved in the development of compact, repetitive, high-duty cycle, linear induction accelerators (LIA). The need for multi-microsecond pulse lengths is incompatible with compact ferrite size. Therefore, a long burst of short pulses with a 100% voltage reversal and a 50% duty cycle was chosen as the operating mode of PTO. The 100% voltage pulse reversals between accelerating pulses reset the magnetic cores, allowing a compact ferrite size. PTO will consist of an 800-kV injector to generate an electron beam (~1 kA) and two 200-kV induction cavities to accelerate the beam. Two different operational modes will be implemented. The first (Drive Mode 1) is a short burst (three pulses) of high frequency (20-MHz) bipolar square waves to study diode beam dynamics and to characterize accelerating cavity behavior. Drive Mode 2 will be a multi-microsecond ringing waveform (with greater impulse spacing) that will alternately saturate the cores in each polarity. The driving mechanism will facilitate the study of plasma closure rates in the diode and accelerating gaps. The pulsed power and cavity designs will be presented.

43822 (SAND—87-0962) Beamline considerations for a compact, high current, high power linear RF electron accelerator. Marder, B. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1987. Contract AC04-76DP00789. 40p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87012512.

A design for a compact, high current, high power linear electron accelerator using an rf power source is investigated. It consists of adjacent cavities into which rf power is injected and through which electron pulses pass. The source is assumed to be capable of delivering sufficient rf power to the desired location at the proper phase. Beamline issues such as cavity loading, energy extraction, longitudinal and transverse pulse focusing, and beam breakup are considered. A device which, given the required source, can deliver beam parameters comparable to existing induction accelerators but which is more than an order of magnitude smaller appears feasible.

43823 (SLAC-PUB—3774) A status report on the SLC program. Prescott, C.Y. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Sep 1985. Contract AC03-76SF00515. 21p. (CONF-8506204—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012319.

From Workshop on tests of electroweak theories, polarized processes and other phenomena; Trieste, Italy (10 Jun 1985).

The SLC program is an accelerator experiment and a physics experiment. The progress in the accelerator experiment has been rapid, with injector and damping ring components working, conventional construction on schedule, and technical components in production. Accelerator studies will investigate beam-linac and beam-beam interactions, with application to the design of future linear colliders. The physics experiments start in 1987 to study Z^0 properties and to look for new physics effects. Detectors to fully exploit the potential physics are under construction.

43824 (SLAC-PUB—4091) Some applications of AI [Artificial Intelligence] to the problems of accelerator physics. Higo, T.; Shoaee, H.; Spencer, J.E. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Sep 1986. Contract AC03-76SF00515. 3p. (CONF-870302—242). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012841.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Failure of orbit correction schemes to recognize betatron oscillation patterns obvious to any machine operator is a good problem with which to analyze the uses of Artificial Intelligence and the roles and relationships of operators, control systems and machines. Because such error modes are very common, their generalization could provide an efficient machine optimization and control strategy. A set of first-order, unitary transformations connecting canonical variables through measured results are defined which can either be compared to design for commissioning or to past results for 'golden orbit' operation. Because these relate directly to hardware variables, the method is simple, fast and direct. It has implications for machine design, controls, monitoring and feedback. Chronological analysis of such machine signatures can predict or provide a variety of information such as mean time to failure, failure modes and fast feedback or feedforward for optimizing figures of merit such as luminosity or current transmission. The use of theoretical and empirical scaling relations for such problems is discussed in terms of various figures of merit, the variables on which they depend as well as their functional dependences.

43825 (TRI-PP—87-8) The TRIUMF KAON Factory proposal. Craddock, M.K. (TRIUMF, Vancouver, British Columbia (Canada)). Feb 1987. 12p. (CONF-870260—6). NTIS (US Sales Only), PC A02/MF A01. File Number DE87900855.

From International workshop hadron facility technology; Santa Fe, NM, USA (2 Feb 1987).

The KAON Factory will provide 30 GeV protons with 100 μA currents - 80 times more intense than available at present and capable of producing correspondingly more intense, or cleaner, beams of secondary particles, particularly kaons, antiprotons and neutrinos. To accelerate a 100 μA beam from the TRIUMF cyclotron a chain composed of two fast cycling synchrotrons and three storage rings has been proposed. Various design features, such as H^- stripping injection, high transition energy and bucket-to-bucket beam transfer, will avoid or reduce beam loss. Recent design developments are summarized, including experimental work on rf cavities and successful demonstrations of the feasibility of extracting H^- ions from the cyclotron. Progress is also reported on the acceleration of polarized protons, the rf separation of kaon beams and on magnet design near production targets. The proposal received favorable technical and economic reviews during 1986. It is now being taken forward to the Canadian government with the strong backing of the Province of British Columbia.

43826 (TRI-PP—87-25) KAON factories in 1987. Craddock, M.K. (British Columbia Univ., Vancouver (Canada). Dept. of Physics; TRIUMF, Vancouver, British Columbia (Canada)). 1987. 6p. (CONF-870302—240). NTIS (US Sales Only), PC A02/MF A01. File Number DE87900864.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Proposals for high intensity proton synchrotrons (typically providing 100 μA (6 x 10^{14} p/s) at 30 GeV) are being made in the USA, Canada, Europe, and Japan. These beams would be roughly 100 times more intense than those available now and would yield equivalent increases in the fluxes of secondary particles (kaons, pions, muons, antiprotons, hyperons, and neutrinos) - or cleaner beams for a smaller increase in flux. The ability to investigate rare processes on the "precision frontier" opens new avenues to fundamental questions in both particle and nuclear physics, complementary to traditional approaches via the "energy frontier." The demand for higher currents has led to novel features in many of the accelerator designs: asymmetric magnet cycles, separate collector and stretcher rings, beam painting at injection, bucket- to-bucket beam transfer, avoidance of crossing transition, perpendicular biassing of ferrite, and the use of Siberian Snakes. Other characteristic features include booster stages, rapid cycling rates, H^- injection, low imped-

ance enclosures, powerful feedback systems for control of beam instabilities and beam loading, and local collimation and fast abort systems for handling beam loss.

43827 **(UCRL—95909) Cost optimization of induction linac drivers for linear colliders.** Barletta, W.A. (Lawrence Livermore National Lab., CA (USA)). 29 Dec 1986. Contract W-7405-ENG-48. 17p. (CONF-8706147—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011560.

From Workshop on new developments in particle acceleration techniques; Orsay, France (29 Jun 1987).

Recent developments in high reliability components for linear induction accelerators (LIA) make possible the use of these devices as economical power drives for very high gradient linear colliders. A particularly attractive realization of this "two-beam accelerator" approach is to configure the LIA as a monolithic relativistic klystron operating at 10 to 12 GHz with induction cells providing periodic reacceleration of the high current beam. Based upon a recent engineering design of a state-of-the-art, 10- to 20-MeV LIA at Lawrence Livermore National Laboratory, this paper presents an algorithm for scaling the cost of the relativistic klystron to the parameter regime of interest for the next generation high energy physics machines. The algorithm allows optimization of the collider luminosity with respect to cost by varying the characteristics (pulse length, drive current, repetition rate, etc.) of the klystron. It also allows us to explore cost sensitivities as a guide to research strategies for developing advanced accelerator technologies.

43828 **RF linacs for SDI.** Jameson, R.A. (Los Alamos National Lab., NM). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **24/25**: No. 2, 725-729(Apr 1987). (CONF-861114—).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Radio-frequency linear accelerators are key elements of Strategic Defense Initiative systems for producing neutral particle beams and for producing photon radiation using free-electron lasers. The R and D work for these applications will result in significant advances in all aspects of accelerators and supporting systems that will also benefit the application of these devices in other areas. Aspects of the current development work are outlined, and prospects for broader application are discussed.

43829 **Accelerator research for heavy ion inertial fusion.** Godlove, T.F. (Dept. of Energy, Washington, DC). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **24/25**: No. 2, 736-740(Apr 1987). (CONF-861114—).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

It is now one decade since serious consideration was first given to the use of heavy ion accelerators for inertial confinement fusion. After an initial period of wide-ranging studies, the US program settled on an induction linac method proposed by Lawrence Berkeley Laboratory (LBL). The ion kinetic energy is modest (30-100 MeV/amu, 5-10 GeV total) but intense beam currents of order 1 kA per beam in 10-30 beams are required on target in a short pulse of order 10-20 ns. In this review the conceptual designs are described, together with recent theory and experiments on high-current beam transport and use of multiple beams. Parallel efforts in West Germany, Japan and the Soviet Union are mentioned, and a two-year US study of heavy ion fusion electric power plants is summarized.

43830 **Brazing techniques for side-coupled electron accelerator structures.** Hansborough, L.D.; Clark, W.L.; DePaula, R.A.; Martinez, F.A.; Roybal, P.L.; Wilkerson, L.C.; Young, L.M. (Los Alamos National Lab., NM). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **24/25**: No. 2, 863-867(Apr 1987). (CONF-861114—).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

The collaboration between the Los Alamos National Laboratory and the National Bureau of Standards (NBS), started in 1979, has led to the development of an advanced cw microtron accelerator design. The four 2380-MHz NBS accelerating structures, containing a total of 184 accelerating cavities, have been fabricated and delivered. New fabrication methods, coupled with refinements of hydrogen-furnace brazing techniques described in this paper, allow efficient production of side-coupled structures. Success with the NBS RTM led to Los Alamos efforts on similar 2450-MHz accelerators for the microtron accelerator operated by the Nuclear Physics Department of the University of Illinois. Two accelerators (each with 17 cavities) have been fabricated; in 1986, a 45-cavity accelerator is being fabricated by private industry with some assistance from Los Alamos. Further private industry experience and refinement of the described fabrication techniques may allow future accelerators of this type to be completely fabricated by private industry.

4302 Beam Dynamics, Field Calculations, And Ion Optics

REFER ALSO TO CITATION(S) 43843, 43844, 43849, 43850, 43856, 43867, 43871, 43873, 43874, 43875, 43896, 44419

43831 **(CONF-870283—12) Neutrino flux calculations for the AGS narrow band beam.** Chi, C.; Kondakis, N.; Lee, W.; O'Brien, E.; O'Halloran, T.; Reardon, K.; Salman, S.; Blumenfeld, B.; Chichura, L.; Chien, C.Y. (Columbia Univ., New York (USA). Dept. of Physics; Illinois Univ., Urbana (USA). Dept. of Physics; Johns Hopkins Univ., Baltimore, MD (USA). Dept. of Physics and Astronomy). 1987. Contract AC02-76ER01195. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013464.

From BNL neutrino workshop; Upton, NY, USA (5 Feb 1987).

Presented are results of calculations of nu/sub μ/ fluxes in the AGS neutrino beam with the new dichromatic horn. The wide band beam nu/sub μ/, as well as the nu/sub e/ backgrounds, are discussed. The nu/sub e//nu/sub μ/ ratio is about 8 x 10^{-3}. The possible sources and magnitudes of uncertainties are discussed. Finally, the calculated fluxes are compared with beam measurements.

43832 **(DOE/ER/40150—34) Correlations and beam noise.** Bisognano, J.J. (Continuous Electron Beam Accelerator Facility, Newport News, VA (USA)). 1986. Contract AC05-34ER40150. 27p. (CEBAF-PR—87-021; CONF-8610108—1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012463.

From 2. joint US/CERN school on particle accelerators: frontiers of particle beams; South Padre Island, TX, USA (23 Oct 1986).

The time-varying currents generated by a particle beam in a storage ring produce rf electromagnetic fields which can be intercepted by a pickup structure for beam diagnostics. The temporal variation of the current has several sources: macroscopic bunching, collective oscillations, and the underlying discrete nature of a particle beam. This discreteness at the microscopic level provides the high-frequency structure necessary for the production of Schottky noise, which is readily observable at rf frequencies, and for the emission of incoherent synchrotron radiation at yet higher frequencies. It is not, however, the discreteness alone, but rather the combination of discreteness and randomness in position of the particles relative to each other that is responsible for the typical spectral character of the noise. If this randomness is not complete - that is, if the particle positions are correlated - the rf signal can be significantly modified and as a function of frequency can be enhanced or suppressed. It is the nature of these correlations and their detailed effects on Schottky noise that are the concern of this paper.

43833 **(DOE/ET/53088—273) Bremsstrahlung from channeled charged particles: Application to a crystal x-ray accelerator.** Cavenago, M.; Tajima, T. (Texas Univ., Austin (USA). Inst. for Fusion Studies). Apr 1987. Contract FG05-80ET53088. 16p. (IFSR—273). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012233.

The ultimate acceleration structure for a very high energy accelerator may be provided by the solid state crystal lattice. We evaluate the interaction between high energy particles and lattice

particles. The mean free path of electrons due to bremsstrahlung is less severe when they are channeled. Even when particles are channeled, however, the bremsstrahlung losses are proportional to the energy of the particle. For a muon or heavier particles this may be tolerable in practical application.

43834 **(LA-UR—87-2321) Acceleration of polarized protons in AHF [Advanced Hadron Facility].** Colton, E.P. (Los Alamos National Lab., NM (USA)). 20 Mar 1987. Contract W-7405-ENG-36. 8p. (CONF-870260—13). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013151.

From International workshop hadron facility technology; Santa Fe, NM, USA (2 Feb 1987).

In this paper an analysis of the depolarization expected during acceleration from 0.8 to 45.0 GeV kinetic energy in the Advanced Hadron Facility (AHF) accelerators is performed.

43835 **(SAND—87-0455) Frozen-field, rigid-beam, uniform-conductivity-channel "Tracking" force calculation.** O'Brien, K.J. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1987. Contract AC04-76DP00789. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012510.

The linearized restoring force, experienced by a displaced rigid-beam entirely contained within a uniform conductivity channel, has been calculated using the frozen-field approximation. It has been determined that for a speed-of-light beam the net restoring force is purely electric, in the sense that part of the electric force exactly cancels the entire magnetic force, leaving only a residual electric force. The force rises with zeta to an asymptotic value which scales as I/sub b/^{2}/a^{3}c^2 dynes (up to geometrical and conductivity factors) for a beam displaced by d whose current rises to a constant value I/sub b/.

43836 **(SLAC-PUB—4161) Open accelerating structures.** Palmer, R.B. (Stanford Linear Accelerator Center, Menlo Park, CA (USA); Brookhaven National Lab., Upton, NY (USA)). Dec 1986. Contract AC03-76SF00515. 13p. (CONF-870891—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010540.

From Symposium on advanced accelerator concepts; Madison, WI, USA (21 Aug 1987).

An "Open" Accelerating Structure must first perform the mode matching function of any accelerating structure, i.e., it must couple an incoming free field to an accelerating mode. The simplest open periodic structure that can be considered is a grating. There has been an attempt to employ an inverse Purcell effect by illuminating a grating from directly above with plane parallel light and passing the particles over the surface of the grating at right angles to the lines. Unfortunately, it has been shown by the Lawson theorem that these geometries fail to accelerate relativistic particles. This paper will restate Lawson's theorem but show that it applies only to the simple two-dimensional situation. It is shown that accelerating fields above grating can be made to fall off exponentially from that surface. Several structures are examined that deal with the problem of fields spreading over the whole grating surface.

43837 **(SLAC-PUB—4227) Beam dynamics in the SLC final focus system.** Bambade, P.S. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Jun 1987. Contract AC03-76SF00515. 6p. (CONF-870302—244). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012839.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The SLC luminosity is reached by colliding beams focused to about 2 μm transverse sizes. The Final Focus System (FFS) must enable, beyond its basic optical design, the detection and correction of errors accumulated in the system. In this paper, after summarizing the design, we review the sensitivity to such errors and the ability to correct them. The overall tuning strategy involves three phases: single beam spot minimization, steering the beams in collision and luminosity optimization with beam-beam effects.

43838 **(SLAC-PUB—4278) Automated emittance measurements in the SLC.** Ross, M.C.; Phinney, N.; Quickfall, G.; Shoaee, H.; Sheppard, J.C. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Mar 1987. Contract AC03-76SF00515. 4p. (CONF-870302—243). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012838.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The emittance of the SLC beam is determined from measurements of the beam width on a profile monitor as a quadrupole field is varied. An automated system has been developed to allow this to be done rapidly and accurately. The image on a fluorescent screen profile monitor (resolution about 20 μm) is read out through an electronic interface and digitized by a transient recorder. A high level software package has been developed to set up the hardware for the measurements, acquire data, fit the beam width, and calculate the emittance.

43839 **(SLAC-PUB—4320) An introduction to acceleration mechanisms.** Palmer, R.B. (Stanford Linear Accelerator Center, Menlo Park, CA (USA); Brookhaven National Lab., Upton, NY (USA)). May 1987. Contract AC02-76CH00016;AC03-76SF00515. 17p. (CONF-8610108—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012835.

From 2. joint US/CERN school on particle accelerators: frontiers of particle beams; South Padre Island, TX, USA (23 Oct 1986).

This paper discusses the acceleration of charged particles by electromagnetic fields, i.e., by fields that are produced by the motion of other charged particles driven by some power source. The mechanisms that are discussed include: Ponderamotive Forces, Acceleration, Plasma Beat Wave Acceleration, Inverse Free Electron Laser Acceleration, Inverse Cerenkov Acceleration, Gravity Acceleration, 2D Linac Acceleration and Conventional Iris Loaded Linac Structure Acceleration. (LSP)

43840 **(TRI-PP—87-10) Rf separation in a 3-6 GeV/c kaon beam.** Doornbos, J. (TRIUMF, Vancouver, British Columbia (Canada)). Feb 1987. 5p. (CONF-870260—5). NTIS (US Sales Only), PC A02/MF A01. File Number DE87900857.

From International workshop hadron facility technology; Santa Fe, NM, USA (2 Feb 1987).

Separated kaon beams in the 3 to 6 GeV/c momentum range are usually produced by using dc separators. However, long separators are required and the vertical angular acceptance is small. In this paper it is proposed to use as an alternative a system of three rf separators. The beam is in the separators parallel in the vertical plane. In this way an order of magnitude better separation is possible than with the dc separation technique. Furthermore, the solid angle acceptance of 6 GeV/c is a factor 2.5 better.

43841 **(TRI-PP—87-16) Polarized protons in the TRIUMF KAON Factory.** Wienands, U. (TRIUMF, Vancouver, British Columbia (Canada)). Feb 1987. 3p. (CONF-870260—7). NTIS (US Sales Only), PC A02/MF A01. File Number DE87900863.

From International workshop hadron facility technology; Santa Fe, NM, USA (2 Feb 1987).

Methods for acceleration of polarized protons in the proposed TRIUMF-KAON Factory without too much depolarization are examined. Two ways of improving polarization transfer will be treated: passing through depolarizing resonances using either fast tune shifts or slow adiabatic spin flip, and reducing the strength of depolarizing resonances by redesigning the lattice using spin matching. It is shown that a combination of the two methods can result in about 70% polarization transfer through the accelerators, providing about 55% polarization of 30 GeV protons.

43842 **(TRI-PP—87-30) Polarized protons in the TRIUMF KAON factory.** Wienands, U. (TRIUMF, Vancouver, British Columbia (Canada)). Mar 1987. 3p. (CONF-870302—236). NTIS (US Sales Only), PC A02/MF A01. File Number DE87900869.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Methods for acceleration of polarized protrons in the proposed TRIUMF KAON factory are examined. Two ways of improving polarization transfer will be treated: reducing the strength of depolarizing resonances by re-designing the lattice using spin matching, and Siberian snakes. It is shown that with a redesigned lattice about 70% polarization transfer through the accelerators is feasible using fast resonance crossing and adiabatic spin flip, providing about 55% polarization at 30 GeV energy. With a Siberian snake in the Driver, essentially no depolarization should occur and about 80% final polarization is feasible.

4303 Auxiliaries And Components

REFER ALSO TO CITATION(S) 43757, 43825, 43838, 43912, 44459, 44739

43843 (ANL-HEP-CP—87-18) The rf system of the Synchrotron X-ray Source at Argonne. Kustom, R.L.; Mavrogenes, G.; Nicholls, G. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 3p. (CONF-870302—208). NTIS, PC A02. File Number DE87011510.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

A Positron Storage Ring for the Synchrotron X-ray Source at Argonne is under design. The rf system is described. The rf system is divided into four stations, each using a one-megawatt klystron to excite four single-cell spherical cavities to a gap voltage of 761 kV at the operating frequency of 350.8 MHz. The same klystron also provides the beam power for synchrotron radiation losses of the position beam of up to 300 mA, the higher-order-mode power losses, the power losses in the beam due to the insertion devices, and the rf power transmission losses. The transmission waveguide system includes magic tees for splitting the power of each klystron to four cavities, isolators to protect the klystrons, harmonic and higher-order-mode absorbers, and mechanical phase shifters for fine phase tuning.

43844 (ANL-HEP-CP—87-19) RF impedance studies of a beam chamber and longitudinally slot-coupled vacuum pumping antechamber. Kustom, R.L.; Nicholls, G.L.; Kramer, S.L.; Khoe, T.K.; Cook, J.M. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 3p. (CONF-870302—225). NTIS, PC A02. File Number DE87011538.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The storage ring vacuum chamber of the proposed 7-GeV synchrotron light source at Argonne National Laboratory is planned to have a semi-elliptical beam chamber, with a longitudinal slot coupled to an antechamber containing NEG pumping strips. Concern over the RF impedance of this complex chamber has stimulated the need to understand the limitations it will have on the beam intensity, the RF acceleration system and on the beam lifetime. Calculations using numerical EM field programs have estimated the waveguide modes of this chamber and the impedance and loss parameter for the expected 1 to 2 cm beam bunch length. The loss parameter is shown to differ little from an elliptical beam chamber without the slot and antechamber. An experimental program has begun to verify the estimates of the impedance for these complex vacuum chamber components using laboratory methods. Preliminary results are presented for the measured loss parameter for a short length of beam vacuum chamber and for other components. These results are compared with their calculated values.

43845 (ANL-HEP-CP—87-28) Ring magnets for the synchrotron x-ray source at ANL. Praeg, W.F.; Thompson, K.M.; Kim, S.H. (Argonne National Lab., IL (USA)). Mar 1987. Contract W-31109-ENG-38. 4p. (CONF-870302—221). NTIS, PC A02. File Number DE87011508.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The designs of the bending, focusing, and correction magnetic for the storage ring are described. The computer-optimized pole-tip contours of the dipole, quadrupole, and sextupole magnets and the construction and assembly techniques keep the field errors within the specified limits. Horizontal and vertical steering corrections are provided by separate magnets in addition to a steering capability included in the sextupole magnets.

43846 (ANL-HEP-CP—87-44) Accelerator based coal positron beams. Schoessow, P.; Simpson, J. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 5p. (CONF-870170—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE87011475.

From Workshop on a linear-collider B anti B factory; Los Angeles, CA, USA (26 Jan 1987).

Cold positron beams produced using solid state moderators have been used profitably for condensed matter and positronium research. The low emittance and energy spread of these beams make the technique attractive as a potential positron source for future linear colliders, reducing or eliminating the need for damping rings. However, the intensities attained so far fall short of the requirements of a high energy linear collider. ($\sim 10^{11}$ positrons/pulse at 10 kHz was taken as the positron flux necessary for a linear collider-B anti B factory). This report briefly reviews the state of the art in accelerator produced coal positron beams and indicates some areas in which yields might be improved. The discussion here is limited to electroproduced positrons.

43847 (BNL—39768) Summary of x-ray ring performance before the 1987 shutdown. Halama, H.J. (Brookhaven National Lab., Upton, NY (USA)). 11 May 1987. Contract AC02-76CH00016. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012116.

On February 28, 1987, the x-ray ring was shut down for major modifications. 627 Ampere hours of time integrated current had been accumulated and lifetimes of 25 and 9 hours had been routinely achieved at 50 and 200 mA, respectively. This paper summarizes pressure and lifetime behavior since the first bakeout in March 1984, when the lifetime at 20 mA was about 20 minutes.

43848 (CONF-870302—226) Development of a very-low-velocity superconducting linac. Shepard, K.W. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 3p. NTIS, PC A02. File Number DE87011536.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Four types of superconducting accelerator structures are being developed for use in a low velocity positive-ion injector linac for the ATLAS heavy-ion accelerator. Prototypes of the first two of these have been tested. The structures are all variants of a quarter-wave line terminated with a four-gap interdigital drift-tube array. The two structure types so far tested operate at 48.5 mHz and have an active length of 10 cm (for the particle velocity - .008c type) and 16.5 cm (for the velocity - .014c type). Effective accelerating fields of 10 MV/m have been achieved with the 10 cm structure, corresponding to an effective accelerating potential of 1 MV. The 16.5 cm structure has been operated at field levels of 6 MV/m, also giving an effective potential of 1 MV. Prototypes of the remaining two resonant geometries are under construction.

43849 (CONF-870302—238) The beam optics of the Argonne Positive-Ion Injector. Pardo, R.C.; Shepard, K.W.; Karls, M. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 4p. NTIS, PC A02. File Number DE87011520.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The beam optics for Phase I of the Argonne Positive-Ion Injector linac system have been studied for a representative set of beams. The results of this study indicate that high charge state beams from an ECR source can be accelerated without significantly increasing the transverse or longitudinal emittance of the initial beam. It is expected that the beam quality from the PII-ATLAS system will be at least as good as presently achieved with the tandem-ATLAS system.

43850 (CONF-870610—3) The ORNL beamline at the National Synchrotron Light Source. Habenschuss, A.; Ice, G.E.; Sparks, C.J.; Neiser, R.A. (Oak Ridge Associated Universities, Inc., TN (USA); Oak Ridge National Lab., TN (USA); Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Dept. of Materials Engineering). 16 Jun 1987. Contract AC05-84OR21400. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011676.

From 5. national synchrotron radiation instrumentation conference; Madison, WI, USA (21 Jun 1987).

The Oak Ridge National Laboratory's (ORNL) beamline at the National Synchrotron Light Source (NSLS) incorporates several novel features including x-ray optics based on sagittal focusing with crystals and a cantilevered mirror whose center becomes the pivot for all downstream optical elements. Crystal focusing accepts a much larger horizontal divergence of radiation than a mirror while maintaining excellent momentum transfer and energy resolution. This sagittally bent crystal serves as the second element of a two-crystal, nondispersive monochromator. The cantilevered mirror provides a simple design for vertical focusing of the radiation. The beamline is suitable for both x-ray scattering and spectroscopy experiments requiring good energy resolution and high intensity in the energy range from 2.5 to 40 keV. This paper describes the optics of the ORNL beamline and reports their performance to date.

43851 (CONF-870610—5) A simple cantilevered mirror for focussing synchrotron radiation. Ice, G.E.; Sparks, C.J. (Oak Ridge National Lab., TN (USA)). 21 Jun 1987. Contract AC05-84OR21400. 19p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87011679.

From 5. national synchrotron radiation instrumentation conference; Madison, WI, USA (21 Jun 1987).

A large cantilevered mirror was constructed to focus the vertical divergence from a synchrotron radiation source. The advantages of this mirror are its compactness, simple bending device, simplicity of construction, and good thermal contact to structures outside the vacuum. The central portion of the mirror is supported with variable loading springs to reduce gravitational sag. The figure and thermal stability of the mirror have proven to be excellent, though the focusing is limited by the roughness of the mirror-surface. This paper describes the design, construction, and performance of the mirror.

43852 (KEK—86-8) Grid pulser for the short beam electron gun of the PF linac. Ohsawa, S.; Asami, A.; Tanaka, J. (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Dec 1986. 20p. (In Japanese). NTIS (US Sales Only), PC A02/MF A01. File Number DE87753025.

A grid pulse generator for a nanosecond short pulse has been developed for the triode type electron gun of the PF linac. The gun and the pulser system generates an electron beam of 1.6 nanoseconds for the single bunch operation of the Tristan Accumulation Ring and the PF storage ring. Although a short beam current of 1.9 A is obtained using the grid pulser in the condition of high vacuum, in the normal operation the current from the gun is typically a few hundred milliamperes. Since it was required to increase the gun current much more for the KEK Positron Generator, characteristics of the pulser were analyzed by means of the equivalent circuit, and it became clear that reduction of the internal impedances of the transisters and the wiring inductances is indispensable to improve the pulser. These results were applied to the grid pulser of the positron generator electron gun, with which the beam current of more than 9 A (4 ns) was successfully obtained.

43853 (KEK—86-9) Performance of high power S-band klystrons focused with permanent magnet. Fukuda, S.; Shidara, T.; Saito, Y.; Hanaki, H.; Nakao, K.; Homma, H.; Anami, S.; Tanaka, J. (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Feb 1987. 43p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87753024.

Performance of high power S-band klystrons focused with permanent magnet is presented. The axial magnetic field distribution and the transverse magnetic field play an important role in the tube performance. Effects of the reversal field in the collector and the cathode-anode region are discussed precisely. It is also shown that the tube efficiency is strongly affected with the residual transverse magnetic field. The allowable transverse field is less than 0.3 % of the longitudinal field in the entire rf interaction region of the klystron.

43854 (LA—11027-MS) Design of the ac dipole and compensation of saturation effects for the LANL synchrotron. Liu, J.; Greene, S. (Los Alamos National Lab., NM (USA)). Aug 1987. Contract W-7405-ENG-36. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012671.

An ac dipole magnet, which can work in two accelerator energy modes of 45 GeV and 60 GeV, is reported for the LANL synchrotron. In order to reach high uniformity of magnetic field distribution in good field region, some effective measures are presented to compensate field errors due to the saturation at both edges of magnet poles.

43855 (LA—11028-MS) A comparison of several designs of H type dipole for an advanced hadron facility. Liu, J.; Greene, S. (Los Alamos National Lab., NM (USA)). Aug 1987. Contract W-7405-ENG-36. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012672.

Several dipole magnets with different features are given and a comparison is made between them. Some possible problems are presented so that a better dipole design could be chosen.

43856 (LA-UR—87-2155) High-brightness electron injectors. Sheffield, R.L. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 13p. (CONF-8703149—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011738.

From Workshop on low emittance beams; Upton, NY, USA (1 Mar 1987).

Free-electron laser (FEL) oscillators and synchrotron light sources require pulse trains of high peak brightness and, in some applications, high-average power. Recent developments in the technology of photoemissive and thermionic electron sources in rf cavities for electron-linac injector applications offer promising advances over conventional electron injectors. Reduced emittance growth in high peak-current electron injectors may be achieved by using high field strengths and by linearizing the radial component of the cavity electric field at the expense of lower shunt impedance.

43857 (LBL—22236) Brightness and coherence of radiation from undulators and high-gain free electron lasers. Kim, Kwang-Je. (Lawrence Berkeley Lab., CA (USA)). Mar 1987. Contract AC03-76SF00098. 7p. (CONF-870302—203). NTIS, PC A02/MF A01; GPO Dep. File Number DE87011093.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The purpose of this paper is to review the radiation characteristics of undulators and high-gain free electron lasers (FELs). The topics covered are: a phase-space method in wave optics and synchrotron radiation, coherence from the phase-space point of view, discussions of undulator performances in next-generation synchrotron radiation facility and the characteristics of the high-gain FELs and their performances. (LSP)

43858 (LBL—23409) The preparation of accelerator targets by the evaporation of acetate-organic solutions in the presence of NH_3 gas. Cai, S.Y.; Ghiorso, A.; Hoffman, D.C. (Lawrence Berkeley Lab., CA (USA)). Mar 1987. Contract AC03-76SF00098. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013985.

The chemical methods described in this paper have been developed for preparation of isotopic targets for bombardment by accelerator-produced ions. Three systems are compared: nitrate-, chloride-, and acetate-organic solutions. The best method was found to be the metallic acetate-organic solution system, evaporated onto the substrate in the presence of ammonia gas. A detailed procedure is given for this method. The targets obtained by the acetate-organic solution system are uniform and adherent. The hydroxide forms fine crystals of good quality for target thicknesses from a few $\mu g/cm^2$ to several mg/cm^2. Thicknesses up to 5 mg/cm^2 of Eu

as the oxide were obtained by this method. The process is simple and fast. 18 refs., 1 tab.

43859 **(PB—87-190641/XAB) Interaction between a high-kinetic-energy plasma jet and a target surface.** Chen, Y.K.; Varghese, P.L.; Howell, J.R. (Texas Univ., Austin (USA). Center for Fusion Engineering). Dec 1986. 24p. (UT/CFE-PR—4). NTIS, PC A02/MF A01.

A model is constructed to estimate the net energy deposited on a target wall bombarded by a plasma jet with gross kinetic energy much greater than its temperature and with density on the order of about 10^{19}/cc (such as the plasma generated by a rail gun). Both one- and two-dimensional cases are examined to study the interactions between incident and reflected plasma ions. The results show that the reflected plasma plays an essential role in stopping the incident plasma energy over some small range of parameters.

43860 **(SAND—87-0081C) Development and testing of the Hermes-III pulse forming transmission lines.** Corley, J.P.; Johnson, D.L.; Weber, G.J.; Denison, G.J.; Pankuch, P.J.; Ramirez, J.J. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1987. Contract AC04-76DP00789. 15p. (CONF-870656—20). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011283.

From 6. Institute of Electrical and Electronic Engineers pulsed power conference; Arlington, VA, USA (29 Jun 1987).

In Hermes III, eighty pulse-forming lines (PFLs) generate 1.1-MV, 220-kA pulses that are added in a parallel/series combination to form a 20-MV, 800-kA pulse that powers an electron beam diode configured to produce bremsstrahlung radiation. In order to achieve the desired pulse width and rise time at the diode, each PFL must produce a 40-ns FWHM pulse with a 10-ns, 10% to 90% rise time and a root mean square (rms) jitter of 4 ns. This paper reports on the development and testing of these units.

43861 **(SAND—87-0084C) Testing of the inductive cores for Hermes III.** Huddle, C.W.; Johnson, D.L.; Denison, G.J.; Franklin, T.L. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 4p. (CONF-870656—19). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011284.

From 6. Institute of Electrical and Electronic Engineers pulsed power conference; Arlington, VA, USA (29 Jun 1987).

This paper describes the testing of magnetic cores for the twenty inductiveiy isolated cavities in Hermes III. In this accelerator, the 1.1-MV, 220-kA outputs from four pulse-forming modules will be added in parallel in each of the twenty cavities. The 1-MV, 800-kA summed pulses are fed through the cavities and added by a Magnetically Insulated Transmission Line (MITL) to produce a 20-MV, 800-kA output pulse. Cores from two manufacturers were procured for testing. Each set of cores was specified to have a 0.064 volt . second product to isolate a 1-MV, 40-ns FWHM pulse. The critical properties of these preannealed, Metglas-alloy 2605C0 cores are their B-H loop characteristics and high-voltage insulation capabilities. The B-H loops measured at 60 Hz, 33 kHz, and with a 60-ns pulse indicate a 3.4-T swing. High-voltage life testing was done with a 250-kV, 60-ns pulser. The cores from both manufacturers were pulsed at the Hermes-III design voltage level for greater than 5000 pulses without failures.

43862 **(SAND—87-0107C) A high-voltage multistage laser-triggered gas switch.** Denison, G.J.; Corley, J.P.; Johnson, D.L.; Weber, G.J.; Hamil, R.A.; Crowder, G.W.; Alexander, J.A.; Petmecky, D.A.; Schanwald, L.P.; Ramirez, J.J. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-870656—15). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011725.

From 6. Institute of Electrical and Electronic Engineers pulsed power conference; Arlington, VA, USA (29 Jun 1987).

This paper describes the development and testing of an SF_6-insulated, multistage laser-triggered gas switch for use in the Hermes-III accelerator at Sandia National Laboratories. Twenty of these switches are used in Hermes III to transfer energy from intermediate energy storage water-dielectric capacitors to the pulse-forming lines (PFLs) and to provide the overall synchronization of the accelerator. The gas switches operate in an oil environment, are charged to a peak voltage between 2.2 MV and 2.4 MV in ~1 μs, and are laser triggered with a root-mean-square (rms) jitter equal to or less than 2 ns. Both the triggered and untriggered performance of the switch have been investigated. A summary of the development tests are presented together with initial results from Hermes III.

43863 **(SAND—87-0189C) Indented-anode diode for HERMES III.** Sanford, T.W.L.; Poukey, J.W.; Halbleib, J.A.; Pate, R.C.; Crowder, G.W.; Borkey, T.; Spencer, P.W.; Bailey, V.; Proulx, G.A.; Kishi, H. (Sandia National Labs., Albuquerque, NM (USA); Pulse Sciences, Inc., San Leandro, CA (USA)). Jul 1987. Contract AC04-76DP00789. 9p. (CONF-870656—29). NTIS, PC A02. File Number DE87011862.

From 6. Institute of Electrical and Electronic Engineers pulsed power conference; Arlington, VA, USA (29 Jun 1987).

Design of three diode configurations that meet the radiation goals of HERMES III and calculation of associated radiation outputs are discussed. These goals are to produce a 20-ns FWHM radiation pulse having a peak dose rate of 5×10^{12} rad(Si)/s with a variation of less than a factor of two over a 500 cm^2 irradiation area, to keep the variation less than a factor of four over the irradiation volume defined by extending the area downstream by 15 cm, and to maintain a minimum dose rate over this volume in excess of 2.5×10^{12} rad(Si)/s.

43864 **(SAND—87-7031C) Troll: A 4-MV peak voltage pulser.** Bushnell, A.H.; Chen, Y.G.; Shannon, J. (Sandia National Labs., Albuquerque, NM (USA); Maxwell Labs., Inc., San Diego, CA (USA)). 1987. Contract AC04-76DP00789. 16p. (CONF-870656—41). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012372.

From 6. Institute of Electrical and Electronic Engineers pulsed power conference; Arlington, VA, USA (29 Jun 1987).

A 4 MV peak voltage pulser for the Troll accelerator has been designed, fabricated, and delivered to Sandia National Laboratories by Maxwell Laboratories, Inc. The pulser is required to produce a flat-top pulse, with a variable width, to drive a cold-cathode diode. The system operates over a range of 2 to 4 MV. A 46-stage Marx generator is used to directly drive the diode. The diode impedance is relatively high (400 to 4000 Ω) and causes overshoot of the output voltage due to the stray capacitance of the Marx generator. To reduce the overshoot, a unique snubber network was used to damp out the oscillations. The pulse width is controlled over a range of 250 ns to 2 μs by a diverter switch. The switch is a hybrid two-stage spark gap, with the first gap in trigatron configuration and the second gap self-closed by overvoltage from the first gap.

43865 **(SLAC-PUB—4329) Exotic damping ring lattices.** Palmer, R.B. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). May 1987. Contract AC03-76SF00515. 6p. (CONF-8703149—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012833.

From Workshop on low emittance beams; Upton, NY, USA (1 Mar 1987).

This paper looks at, and compares three types of damping ring lattices: conventional, wiggler lattice with finite α, wiggler lattice with $\alpha = 0$, and observes the attainable equilibrium emittances for the three cases assuming a constraint on the attainable longitudinal impedance of 0.2 ohms. The emittance obtained are roughly in the ratio 4:2:1 for these cases.

43866 **(TRI-PP—87-11) Status of rf development work on a ferrite tuned amplifier cavity for the TRIUMF KAON factory booster ring.** Poirier, R.L.; Enegren, T. (TRIUMF, Vancouver, British Columbia (Canada)). Feb 1987. 4p. (CONF-870260—9). NTIS (US Sales Only), PC A02/MF A01. File Number DE87900858.

From International workshop hadron facility technology; Santa Fe, NM, USA (2 Feb 1987).

Of the five synchrotron rings in the proposed TRIUMF KAON factory, the Booster ring to accelerate the proton beam from 440 MeV to 3 GeV has the most demanding rf requirements,

primarily because of the relatively large frequency swing of 46.1 MHz to 61.1 MHz at a high repetition rate of 50 Hz. In the current reference design, the Booster lattice has twelve 3.9 m drift spaces with 2.5 m in each drift space available for installation of rf cavities to provide a required effective acceleration voltage of up to 600 kV per turn, i.e., 50 kV per cavity. Design and development studies of a suitable cavity-amplifier system are in progress. For the initial reference design a system based on the one used in the Fermilab booster synchrotron has been chosen. That is, a double-gap drift-tube cavity with parallel-biased ferrite tuners and excited with a directly coupled Eimac Y567B tetrode. To meet the tuning and voltage requirements within the various mechanical and other constraints such as tube to gap voltage ratio, ferrite power density and available space, the reference design had to be further modified and a cold model of the cavity and tuners was constructed from copper-covered cardboard cylinders. From the results of the cold model measurements a new reference design was established and design work has begun on a full power prototype of the cavity-amplifier system.

43867 **(TRI-PP—87-12) Coupled bunch instabilities in kaon factory synchrotrons.** Baartman, R. (TRIUMF, Vancouver, British Columbia (Canada)). Feb 1987. 6p. (CONF-870260—11). NTIS (US Sales Only), PC A02/MF A01. File Number DE87900859.

From International workshop hadron facility technology; Santa Fe, NM, USA (2 Feb 1987).

Synchrotrons for kaon factories will not necessarily break new ground in terms of instabilities: high average beam intensity is attained by rapid cycling rather than by a high circulating current. As compared with the CPS or the AGS, the rapid-cycling nature impacts upon kaon factory synchrotrons in two ways: (1) there is more total impedance due to rf cavities, so that both the number of cavities and their individual impedances should be minimized; (2) the beam pipe impedance needs to be large to minimize eddy currents. This exacerbates the resistive wall effect unless the beam pipe is constructed of an insulator with a thin highly conductive coating.

43868 **(TRI-PP—87-13) A preliminary concept for the design of magnets at target locations.** Otter, A.; Hojvat, C. (TRIUMF, Vancouver, British Columbia (Canada); Fermi National Accelerator Lab., Batavia, IL (USA)). Feb 1987. 3p. (CONF-870260—10). NTIS (US Sales Only), PC A02/MF A01. File Number DE87900860.

From International workshop hadron facility technology; Santa Fe, NM, USA (2 Feb 1987).

A new concept of magnets with long poles is proposed for utilization in very high radiation environments, for example, at target stations. The main advantages are the possibility of locating the magnet coils at regions of low radiation field level and the elimination of vacuum joints between magnets. These two features should overcome maintenance limitations with present designs.

43869 **(TRI-PP—87-14) Dual frequency resonant magnet excitation.** Reiniger, K.; Lacey, W.K. (TRIUMF, Vancouver, British Columbia (Canada); DSMA Atcon Ltd., Toronto, Ontario (Canada)). Feb 1987. 3p. (CONF-870260—12). NTIS (US Sales Only), PC A02/MF A01. File Number DE87900861.

From International workshop hadron facility technology; Santa Fe, NM, USA (2 Feb 1987).

This paper deals with the magnet system envisaged for the TRIUMF KAON factory. It covers some of the design considerations resulting in the final choice of dual frequency resonant magnet excitation as well as the presentation of a preliminary design for a capacitor switch.

43870 **(TRI-PP—87-27) Status of rf development work on a ferrite tuned amplifier cavity for the TRIUMF KAON factory.** Poirier, R.L.; Enegren, T. (TRIUMF, Vancouver, British Columbia (Canada)). Mar 1987. 3p. (CONF-870302—233). NTIS (US Sales Only), PC A02/MF A01. File Number DE87900866.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Of the five synchrotron rings in the proposed TRIUMF KAON factory, the Booster ring to accelerate the proton beam from 440 MeV to 3 GeV has the most demanding rf requirements, primarily because of the relatively large frequency swing of 46.1 MHz to 61.1 MHz at a high repetition rate of 50 Hz. In the current reference design, the Booster lattice has twelve 3.9 m drift spaces with 2.5 m in each drift space available for installation of rf cavities to provide a required effective acceleration voltage of up to 600 kV per turn, i.e., 50 kV cavity. Design and development studies of a suitable cavity-amplifeier system are in progress. For the initial reference design a system based on the one used in the Fermilab booster synchrotron has been chosen. That is, a double-gap drift-tube cavity with parallel-biased ferrite tuners and excited with a directly coupled Eimac Y567B tetrode. Design procedure used to meet the tuning and voltage requirements within the various mechanical and other constraints, such as tube to gap voltage ratio, ferrite power density and available space will be discussed along with results from cold model tests.

43871 **(TRI-PP—87-28) Cavity-induced instabilities in kaon factory synchrotrons.** Baartman, R. (TRIUMF, Vancouver, British Columbia (Canada)). Mar 1987. 3p. (CONF-870302—234). NTIS (US Sales Only), PC A02/MF A01. File Number DE87900867.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Synchrotrons for kaon factories will not necessarily break new ground in terms of instabilities: high average beam intensity is attained by rapid cycling rather than by a high circulating current. As compared with the CPS or the AGS, the rapid-cycling nature means that there is more total impedance due to rf cavities. Both the number of cavities and their individual impedances should be minimized.

43872 **(TRI-PP—87-29) Slow extraction from the KAON factory extender ring.** Wienands, U. (TRIUMF, Vancouver, British Columbia (Canada)). Mar 1987. 3p. (CONF-870302—235). NTIS (US Sales Only), PC A02/MF A01. File Number DE87900868.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The Extender ring for the proposed KAON factory at TRIUMF will employ 1/3-integer resonant extraction to spill out the protons slowly and provide experiments with a continuous beam. An array of sextupoles is provides to excite the 3 nu/sub x/ = 34 stopband. A combination of electrostatic and magnetic septa will guide the extracted beam into the beamline. Chromatic extraction, using the natural chromaticity of the ring to shift the tune towards the resonance, or achromatic extraction from a chromaticity-corrected machine using tune-shift quadrupoles, can be used to drive the particles into instability. Results of tracking studies show that by achromatic extraction an extracted emittance of less than 1 πmm-mrad can be achieved.

43873 **(TRI-PP—87-31) Improvements in the stability of the TRIUMF rf resonator.** Worsham, R.; Dohan, D.; Dutto, G.; Fong, K.; Pacak, V.; Stanford, G. (TRIUMF, Vancouver, British Columbia (Canada)). Mar 1987. 3p. (CONF-870302—237). NTIS (US Sales Only), PC A02/MF A01. File Number DE87900870.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The resonator at TRIUMF is a flattened coaxial stub 16 m wide, 6 m long and 4.0 m high contained within the vacuum tank and magnetic field of the cyclotron. The structure is comprised of 80 separate 3 m long by 0.8 m wide segments, consisting of a cantilevered hot arm and an opposing cold arm attached to the vacuum chamber. The beam gap inside the dees forms a cavity with two modes near the 23.06 MHz operating rf frequency. Multipactoring with peak power densities in excess of 600 W/m^2 can be excited in this region by the leakage field. In the past, this has caused substantial mechanical and electrical instabilities in the system because of induced thermal distortions that were difficult to control. For improved stability the resonator is being upgraded with newly designed, more rigid segments that have cooled beam-side panels to isolate the mechanical supports from the heat of multipactoring. Eight new resonator segments have already been installed in the most critical locations. In addition, remote tip control on several

segments has been implemented to reduce the coupling between rf cavity and beam cavity. The results are a tenfold reduction in leakage voltage, with lower temperatures, improved dee tip alignment, better vacuum, better beam diagnostics, and increased operating time.

43874 **(TRI-PP—87-32) A scanning secondary emission profile monitor.** Rawnsley, W.R.; Ries, T.C.; Mackenzie, G.H. (TRIUMF, Vancouver, British Columbia (Canada)). Mar 1987. 3p. (CONF-870302—227). NTIS (US Sales Only), PC A02. File Number DE87900871.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Harp profile monitors have been used in the primary beam lines at TRIUMF. Disadvantages include a fixed, sometimes too coarse, resolution, changes in wire-to-wire efficiency and restrictions on multiple insertion. A secondary emission scanning wire system has been developed. A beam sensor is mounted to each of two parallel linkage systems driven, via a ferrofluidic feedthrough, by a stepping motor controlled cam. This mechanism moves the sensors linearly across the beam and keeps them perpendicular to each other and to the beam pipe axis. The precision is +-0.13 mm over 100 mm sweep. Magnetic sensors provide fiducial indications. Wire sensors are used at ~100 μA; blades 10 mm long by 0.25 mm wide at nA intensities. The sweep frequency is 0.5 Hz, chosen for mechanical stability and to provide a usable profile for a beam modulated at 1 kHz. The spatial resolution requires an electronic bandwidth of greater than 300 Hz. Noise within the monitor was reduced by employing shielded wiring and stationary bias field electrodes. 60 Hz pick up between the monitor and remote electronic was reduced by using balanced cable and a differential amplifier. The overall rms noise level is equivalent to a beam density of 0.1 nA/mm of blade movement.

43875 **(TRI-PP—87-33) An external monitor of beam loss in an H^- cyclotron.** Ries, T.C.; Rawnsley, W.R.; MacKenzie, G.H.; Laxdal, R.E. (TRIUMF, Vancouver, British Columbia (Canada)). Mar 1987. 3p. (CONF-870302—228). NTIS (US Sales Only), PC A02. File Number DE87900872.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The TRIUMF cyclotron accelerates H^- ions from 0.3 to 520 MeV. Beam may be lost by dissociation or by collision with mechanical objects in the vacuum tank. To reduce the activation of these components, and to monitor the loss, thin foils have been installed to define the vertical aperture for the beam. The foil's projection toward the median plane is greater than that of any other component; they strip H^- ions with a large vertical amplitude to H^+. Their location (R,θ) is such that the H^+ ions are energy dispersed along a short region of tank wall. They pass through a thin, 0.8 mm steel, section of wall to enter a thin ion chamber lying between the wall and the surrounding magnet yoke. The chamber is flushed with Ar/CO_2 gas and the anode-cathode spacing is 6 mm in order to reduce ion recombination. The anode is segmented along the plane of dispersion to yield the region of beam loss. The device is radiation hard, including cabling, and may be removed or installed remotely. It has been calibrated by inducing known amounts of local beam loss and the coefficient scales with stopping power and ion path length as expected.

43876 **(TRI-PP—87-34) An intense ion source for H^- cyclotrons.** Baartman, R.; Kendall, K.R.; McDonald, M.; Schmor, P.W.; Yuan, D. (TRIUMF, Vancouver, British Columbia (Canada)). Mar 1987. 3p. (CONF-870302—229). NTIS (US Sales Only), PC A02. File Number DE87900873.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

An H^- ion source, employing multicusp plasma confinement and a magnetic filter to enhance volume H^- production, has been developed for the TRIUMF cyclotron. The source was designed to operate in a dc mode, to have a long filament lifetime and to provide an intense H^- beam of low emittance. The emittance could be easily scaled, without affecting the current density, to match the acceptance of the cyclotron. The H^- beam is initially transported ~1.7 m at 25 keV with a measured 94 +- 1% space charge neutralization. A 9.4 m long beam line, containing only electrostatic optics, has been built to transport the H^- beam from a high voltage terminal into the existing cyclotron injection beam line. The source design, operating characteristics, beam quality measurements and initial operating experience with the TRIUMF cyclotron are described.

43877 **(TRI-PP—87-35) The TRIUMF optically pumped polarized H^- ion source.** Levy, C.D.P.; McDonald, M.; Schmor, P.W. (TRIUMF, Vancouver, British Columbia (Canada)). 1987. 3p. (CONF-870302—230). NTIS (US Sales Only), PC A02. File Number DE87900874.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The optically pumped polarized H^- ion source at TRIUMF is capable of producing ≃10mA of H^- at a polarization of ≃65%, within a normalized emittance at the 60% contour level of 0.4π mm.mrad for an ionizing field of 1.5 kG. Relaxation rates of electron spin <S/sub z/> of optically pumped sodium atoms have been measured as a function of magnetic field. The relaxation rate using copper walls at high fields corresponded to 5 to 10 wall collisions before depolarization occurred. The H^+ charge neutralization cross section was independently remeasured to be 4.35 +- 0.25 x 10^{-15} cm^2 for 5 keV protons in sodium.

43878 **(TRI-PP—87-36) Magnetic channel design concepts for the extraction of H^- ions from the TRIUMF cyclotron.** Pearson, J.B.; DeVita, E.; Laxdal, R.; Lee, R.; Mackenzie, G.H.; Ries, T.C.; Trelle, R.; Zach, M. (TRIUMF, Vancouver, British Columbia (Canada)). Mar 1987. 3p. (CONF-870302—231). NTIS (US Sales Only), PC A02. File Number DE87900875.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

A scheme to extract 450 MeV H^- ions from the TRIUMF cyclotron will require the use of two types of magnetic channel. An electrostatic deflector will produce the initial separation between circulating and extracted beams. This will be followed by a magnetic channel with a radially narrow septum. As the separation increases, more efficient coaxial channels with cosθ windings would lead the beam out of the cyclotron. A design is presented for a prototype septum channel, and engineering tests performed on critical subcomponents are described. The radiation-resistant, iron-free channel will have a septum width of 15 mm and generate a peak field reduction of 75 mT, with a mean deflecting power of 60 mT.m. The design, incorporating three independently powered coils, was aided by the use of two and three-dimensional relaxation codes. The coaxial design has a wider effective septum of 55 mm but produces four times the field with proportionally less fringe field. The design concepts of this channel are also presented.

43879 **(TRI-PP—87-37) A modular rf control system at TRIUMF.** Enegren, T.; Burge, R.; Dohan, D.A. (TRIUMF, Vancouver, British Columbia (Canada)). Mar 1987. 3p. (CONF-870302—224). NTIS (US Sales Only), PC A02. File Number DE87900876.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

New rf systems planned for installation at TRIUMF in the near future include a third harmonic flat-topping system, a fourth harmonic booster cavity and an rf extraction deflector operating at the 11.5 MHz subharmonic of the main frequency. A new modular rf control concept is being adopted to develop the basic building blocks for each of the required rf control systems. One of the main design considerations is that all parameters are to be accessible and controllable by an external central computer. This will permit the computer to utilize expert systems and adaptive control techniques for remote debugging and loop parameter optimization. In order to carry out diagnostics on individual rf systems it is necessary that the control system be totally operational in a local manual mode, independent of the central computer with smooth transitions between computer and local control. This paper discusses the design of the new control system and its application to a full power flat-topping rf model cavity.

43880 **(TRI-PP—87-38) Application of high level programs in a controls environment.** Kost, C.J.; Mouat, M.; Dohan, D.A. (TRIUMF, Vancouver, British Columbia (Canada)). Mar 1987. 4p. (CONF-870302—223). NTIS (US Sales Only), PC A02. File Number DE87900877.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Highly interactive display utilities, operating on a VAX/VMS computer system, have been usefully interfaced to the controls environment of the TRIUMF cyclotron. Machine data is acquired by a VAX-CAMAC interface, and is passed to these utilities in an efficient manner by memory mapping to global sections for on-line manipulation. The data can also be readily analyzed off-line by operators with the user friendly command driven utilities OPDATA and PLOTDATA which permit the user to obtain graphics output on a variety of terminal and hardcopy devices using device independent metafiles. Sample applications show the usefulness of these utilities for a wide range of tasks, such as real-time simulation of trim-coil tuning on the beam phase history, and semi-on-line analysis of radial probe data.

43881 **Atlas positive-ion injector project.** Pardo, R.C.; Bollinger, L.M.; Shepard, K.W. (Argonne National Lab., IL). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **24/25**: No. 2, 746-751(Apr 1987). (CONF-861114—). Contract W-31-109-ENG-38.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

The goal of the Argonne Positive Ion Injector project is to replace the ATLAS tandem injector with a facility which will increase the beam currents presently available by a factor of 100 and to make beams of essentially all elements including uranium available at ATLAS. The beam quality expected from the facility will be at least as good as that of the tandem based ATLAS. The project combines two relatively new technologies - the electron cyclotron resonance ion source, which provides ions of high charge states at microampere currents, and rf superconductivity which has been shown to be capable of generating accelerating fields as high as 10 MV/m resulting in an essentially new method of acceleration for low-energy heavy ions.

43882 **Emittance studies of high intensity negative ion sources equipped with continuous surface cylindrical and spherical geometry tungsten ionizers.** Alton, G.D.; McConnell, J.W.; Tajima, S.; Nelson, G.J. (Oak Ridge National Lab., TN). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **24/25**: No. 2, 826-833(Apr 1987). (CONF-861114—). Contract AC05-84OR21400.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

A digitally controlled emittance measurement, data acquisition and processing system has been designed, implemented and used to determine emittances of negative ion beams extracted from high intensity negative ion sources equipped with cylindrical and spherical geometry cesium surface ionizers. Comparative studies indicate that the emittances of ion beams extracted from the source equipped with a spherical geometry ionizer are lower by 13-21% than those extracted from the source equipped with a cylindrical geometry ionizer. This difference may be attributable to geometric factors rather than differences in the sizes of the emission areas at the points of negative ion generation. Studies reveal that the emittances of these sources are independent of ion mass for most of the materials investigated and independent of ion current over the range of ion currents used in these investigations (4-12 μA).

43883 **Applications of the MEVVA high current metal ion source.** Brown, I.G. (Lawrence Berkeley Lab., CA). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **24/25**: No. 2, 841-844(Apr 1987). (CONF-861114—). Contract AC03-76SF00098.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

A new kind of ion source has been developed in which a Metal Vapor Vacuum Arc (MEVVA) is used to produce the plasma from which the ion beam is extracted. The novel and exciting feature of this source is the very high metal ion beam current attainable. A total ion beam current of over 1 Ae has been extracted from the embodiment of the concept that we are presently using, and this is not a limit of the method. The source was developed to upgrade the uranium ion beam intensity of the Bevatron, LBL's heavy ion synchrotron, for basic nuclear physics research. Other important applications include its use within the Heavy Ion Fusion research effort; for ion implantation; and for other basic research uses. In this paper the source is described briefly, its performance outlined, and its potential and limitations for a variety of applications is discussed.

43884 **Use of molybdenum ion source electrodes at RTNS-II.** Massoletti, D.J.; Harter, G.A.; Heikkinen, D.W. (Lawrence Livermore National Lab., CA). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **24/25**: No. 2, 852-854(Apr 1987). (CONF-861114—). Contract W-7405-ENG-48.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Results are reported for an ongoing effort to optimize D^+ beam production by the MATS-III ion source used at RTNS-II. The three seven-aperture electrodes, originally consisting of water-cooled copper, have now been tested using uncooled molybdenum and with water cooling on the second (decel) electrode only. Details of the change, the results of the testing, and the benefits in operation, performance and cost are given.

43885 **Oxide cathode lifetime improvements at RTNS-II.** Massoletti, D.J. (Lawrence Livermore National Lab., CA). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **24/25**: No. 2, 855-857(Apr 1987). (CONF-861114—). Contract W-7405-ENG-48.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Also published as report UCRL—94798; CONF-861114—14-10.

Results are reported for an ongoing effort to optimize D^+ beam production by the MATS-III ion source used at the RTNS-II. The oxide cathode assembly originally designed for lower power operation has been modified and redesigned for higher electron current yield, longer life and serviceability. A factor of 2.5 has been gained in cathode lifetime due to these changes. The details of the changes and results and benefits in operation and performance are given. In addition, the technique used for manufacture of the filament is described.

43886 **White neutron source from 1 to 400 MeV.** Wender, S.A.; Lisowski, P.W. (Los Alamos National Lab., NM). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **24/25**: No. 2, 897-900(Apr 1987). (CONF-861114—).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

A new high-intensity white neutron source has recently been constructed at Los Alamos. Beams of neutrons with a continuous energy distribution up to several hundred MeV are produced by the spallation reaction using the 800-meV pulsed proton beam from the Los Alamos Meson Physics Facility (LAMPF) linear accelerator. The neutron facility has been designed to make very efficient use of the LAMPF beam with several experiments being able to operate simultaneously. Typical running conditions involve approximately 50 000 bursts/s and proton beam currents of 2.5 μA. Experiments planned for this fall include gamma-ray production, neutron induced fission, and medium energy (n,p) and (p,n) studies.

43887 Design for a high intensity slow positron facility using forward scattered radiation from an electron linear accelerator. Hulett, L.D. Jr.; Lewis, T.A.; Alsmiller, R.G. Jr.; Peelle, R.; Pendyala, S.; Dale, J.M.; Rosseel, T.M. (Oak Ridge National Lab., TN). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **24/25**: No. 2, 905-908(Apr 1987). (CONF-861114—). Contract AC05-84OR21400.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

A tungsten moderator will be placed behind the target of the Oak Ridge Electron Linear Accelerator (ORELA) to convert gamma radiation to slow positrons. These will be extracted and led through evacuated solenoids to an experiment room. A Penning trap will be used to extend the slow positron pulses to achieve duty factors of 10% or greater. The facility will be used for atomic and molecular physics studies, positron microscopy, and materials research. Operations will be inexpensive and will not interfere with the normal function of ORELA, the measurement of neutron cross sections by flight-time spectrometry.

43888 Production of short-lived radiopharmaceuticals for PET. Schlyer, D.J. (Brookhaven National Lab., Upton, NY). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **24/25**: No. 2, 925-927(Apr 1987). (CONF-861114—).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Research projects currently being undertaken in the area of positron emission tomography (PET), require the use of very high specific activity radiopharmaceuticals. The cyclotron targetry necessary to produce near carrier free radiopharmaceuticals has posed some interesting and challenging problems in target design and construction. Radionuclides are produced at Brookhaven from gas, liquid and solid targets. Each of these phases of matter has its own special problems associated with it. Besides the normal design considerations such as heat transfer, density reduction and beam scattering, other factors such as radiation damage to metal surfaces, surface wetting angles, transport line materials and solder fluxes must also be taken in account in the design of the target. The most difficult target in which to maintain the isotopic purity has proven to be the ^{11}C from nitrogen gas target. The most difficult target in which to maintain the chemical form and reactivity over long periods of time is the ^{18}F from ^{18}O water target. These targets and the design consideration which went into them are discussed in detail.

43889 Isotope materials availability and services for target production at the Oak Ridge National Laboratory. Ratledge, J.E.; Dahl, T.L.; Ottinger, C.L.; Aaron, W.S.; Adair, H.L. (Oak Ridge National Lab., TN). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **24/25**: No. 2, 937-943(Apr 1987). (CONF-861114—). Contract AC05-84OR21400.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Materials available through the Isotope Distribution Program include separated stable isotopes, byproduct radioisotopes, and research quantities of source and special nuclear materials. Isotope products are routinely available in the forms listed in the product description section of the Isotopes Products and Services Catalog distributed by the Oak Ridge National Laboratory (ORNL). Different forms can be provided in some cases, usually at additional cost. Routinely available services include cyclotron target irradiations, fabrication of special physical forms, source encapsulation, ion implantation, and special purifications. Materials and services that are not offered as part of the routine distribution program may be made available from commercial sources in the United States. Specific forms of isotopic research materials include thin films and foils for use as accelerator targets, metal or other compounds in the form of bars or wires, and metal foils. Methods of fabrication include evaporation, sputtering, rolling, electrolytic deposition, pressing, sintering, and casting. High-purity metal forms of plutonium, americium, and curium are prepared by vacuum reduction/distillation. Both fissionable and nonfissionable neutron dosimeters are prepared for determining the neutron energy spectra, flux, and fluence at various locations within a reactor. Details on what materials are available and how the materials and related services can be obtained from ORNL are described.

43890 Development of a polarized deuterium target by spin exchange with optically pumped K. Young, L.; Holt, R.J.; Green, M.C.; Kowalczyk, R.S. (Argonne National Lab., IL). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **24/25**: No. 2, 963-966(Apr 1987). (CONF-861114—). Contract W-31-109-ENG-38.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

The development of a polarized internal target at an electron storage ring is of great interest for studies in nuclear physics. The deuterium nuclei acquire polarization via the hyperfine interaction after electron spin exchange with optically pumped potassium vapor. A high power laser which covers the entire Doppler width and hyperfine splitting of the $^2S_12/-^2P_12/$ transition in potassium has been developed. Spin relaxation rates for potassium on various wall coatings have been measured. A dri-film surface has been shown to preserve polarization (>100 bounces), be long-lived at elevated temperatures, and to be efficient at preventing deuterium recombination.

43891 Cooled ion beams for physics experiments. Mills, F.E. (Fermi National Accelerator Lab., Batavia, IL). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **24/25**: No. 1, 38-42(Apr 1987). (CONF-861114—).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Beam cooling methods developed for high energy colliders of protons and antiprotons are now finding application as media for experimentation in Nuclear and Atomic Physics. Two principal methods have been employed, stochastic cooling and electron cooling. The physics of these methods, and their ranges of applicability are discussed.

43892 Design considerations for a combined synchrotron light source and heavy-ion storage ring atomic physics facility. Jones, K.W.; Johnson, B.M.; Meron, M.; Lee, Y.Y.; Thieberger, P.; Thomlinson, W.C. (Brookhaven National Lab., Upton, NY). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **24/25**: No. 1, 381-390(Apr 1987). (CONF-861114—). Contract AC02-76CH00016.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

An atomic physics facility (APF) based on the combination of photons produced by a synchrotron light source with heavy ions in a storage ring will open the way to the study of ionic states of almost all elements. The design considerations for such a facility are discussed in terms of the use of synchrotron radiation for photoexcitation and ionization experiments. Design considerations for an APF are given in terms of the accelerator facilities presently available at BNL which include the National Synchrotron Light Source and Tandem Van de Graaff Laboratory. The results show that the concept is valid and therefore that implementation would result in entirely new capabilities for the study of multiply-ionized atoms.

43893 Atomic physics and synchrotron radiation: The production and accumulation of highly charged ions. Johnson, B.M.; Meron, M.; Agagu, A.; Jones, K.W. (Brookhaven National Lab., Upton, NY). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **24/25**: No. 1, 391-396(Apr 1987). (CONF-861114—). Contract AC02-76CH00016.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Synchrotron radiation can be used to produce highly-charged ions, and to study photoexcitation and photoionization for ions of virtually any element in the periodic table. To date, with

few exceptions, atomic physics studies have been limited to rare gases and a few metal vapors, and to photoexcitation energies in the VUV region of the electromagnetic spectrum. These limitations can now be overcome using photons produced by high-brightness synchrotron storage rings, such as the X-ray ring at the National Synchrotron Light Source (NSLS) at Brookhaven. Furthermore, calculations indicate that irradiation of an ion trap with an intense energetic photon beam will result in a viable source of highly-charged ions that can be given the name PHOBIS: the photon beam ion source. Promising results, which encourage the wider systematic use of synchrotron radiation in atomic physics research, have been obtained in recent experiments on VUV photoemission and the production and storage of multiply-charged ions. An overview of the field, current plans, and future possibilities will be presented.

43894 Radioactive ion beam research at Lawrence Livermore National Laboratory. Sale, K.E.; Bauer, R.W.; Boyd, R.N.; Mathews, G.J.; Haight, R.C.; Corn, P.B. (Lawrence Livermore National Lab., CA; Los Alamos National Lab., NM; Ohio State Univ., Columbus). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **24/25**: No. 1, 490-492(Apr 1987). (CONF-861114—). Contract W-7405-ENG-48.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Also published as report UCRL—95451; CONF-861114—14-8.

Several modifications and additions have been made to improve the radioactive beam facility at Livermore with the main aim of measuring the cross section for $^{7}Be(p\gamma)^{8}B$ (which is important in determining the solar neutrino flux) and other reactions of astrophysical interest. The quadrupole sextuplet spectrometer has been upgraded by inserting an electrostatic deflection element near the midpoint and by installing a movable beam stop near the ^{7}Be production target. These changes have allowed an improvement in the purity, and large increase in the intensity, of the ^{7}Be beam. Six large NaI(Tl) detectors and the gas cell from OSU system along with its active and passive shielding have been incorporated into the Lawrence Livermore facilty. True events are to be identified by a multiple coincidence. The first requirement is the detection of a γ-ray from the proton capture $^{7}Be(p,\gamma)^{8}B$. After the candidate capture gamma is observed the ^{8}B decay signature is required. This signature is a positron (from $^{8}B->{}^{8}Be/sup\ */+e^{+}+\nu$) along with the two α's from $^{8}Be->\alpha+\alpha$ observed in a CaF_2 detector into whicn the ^{8}B have implanted. Also a detector telescope inside the gas cell monitors the incoming ^{7}Be beam. The current status of the $^{7}Be(p,\gamma)^{8}B$ measurement is discussed.

4304 Storage Rings

REFER ALSO TO CITATION(S) 43845, 43870

43895 (TRI-PP—87-15) Siberian snakes for the TRIUMF KAON Factory. Wienands, U. (TRIUMF, Vancouver, British Columbia (Canada)). Feb 1987. 3p. (CONF-870260—8). NTIS (US Sales Only), PC A02/MF A01. File Number DE87900862.

From International workshop hadron facility technology; Santa Fe, NM, USA (2 Feb 1987).

The feasibility of incorporating "Siberian Snakes" into the Driver ring of the proposed KAON Factory is investigated. Due to the relatively low injection energy of 3 GeV, chosen for maximum cost efficiency, orbit distortions in the snake magnets tend to be unacceptably large. Novel designs, however, like the helical snake or the discretized helix proposed here, promise reduced orbit excursions that are further reduced by using superconducting magnets with a field of 3 T. In this way, orbit excursions are reduced to a few cm as opposed to several tens of cm. Systematics of these designs are investigated and the insertions necessary for the lattice are discussed. It is shown that incorporation into the lattice can be achieved without undue distortion of the lattice functions.

43896 (ORNL/tr—87/15) Beam position determination for the Test Storage Ring. Baumann, P. (Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.); Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. Translation source information not available . 140p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87011875.

The Test Storage Ring (TSR) for heavy ions, currently under design and construction at the Max Planck Institute for Nuclear Physics in Heidelberg, requires an extensive beam diagnostics system in order to enable it to operate without friction. This thesis concerns the beam position determination sub-system of this diagnostics system which is intended to determine the beam center of gravity of a bunched beam inside the cross section of the beam tube in a non-destructive manner. An electrostatic pickup is used to sense the location of the beam; the mode of operation of this device will be explained in detail. The signals go to a preamplifier from where they are then sent via a multiplex system to the measuring unit. This point also represents the interface to the computer system that controls the TSR. The prototype developed here was tested with the aid of a particle beam, as well as with other measurement methods. Resolutions of better than 1 mm about the center have been measured. In order to achieve or even improve such resolutions later in actual operation, it is possible to determine the properties of the preamplifiers with the aid of calibration signals and to take these into account in the course of the signal evaluation in the computer. The differences between the individual electrodes of a given pickup must also be compensated. These procedures and their associated electronic circuits are also described in this paper.

44 INSTRUMENTATION

4401 Radiation Instrumentation

REFER ALSO TO CITATION(S) 43124, 43731, 43863, 44027, 44047, 44186, 44238, 44517, 44671

43897 (ANL-HEP-CP—87-38) Performance of the Soudan II honeycomb drift chambers. Ambats, I.; Ayres, D.; Barrett, W.; Dawson, J.; Fields, T.; Goodman, M.C.; Lopez, F.; May, E.; Price, L.; Schlereth, J. (Argonne National Lab., IL (USA); Minnesota Univ., Minneapolis (USA); Oxford Univ. (UK); Rutherford Appleton Lab., Chilton (UK); Tufts Univ., Medford, MA (USA)). 1987. Contract W-31109-ENG-38. 4p. (CONF-870855—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011473.

From 20. international cosmic ray conference; Moscow, USSR (2 Aug 1987).

The Soudan II nucleon decay project is in the process of building 260 identical 5-ton fine grained calorimeter modules for the study of nucleon decay and cosmic ray physics in the Soudan Iron Mine in Minnesota. Several of these modules have been studied on a cosmic ray test stand on the surface at Argonne National Lab. Several have been installed on location in the mine, 700 m under the surface (2200 mwe overburden). In addition, many studies of trigger efficiency, pattern recognition and background rejection have been done using Monte Carlo techniques.

43898 (ANL-HEP-CP—87-39) Initial results from the Soudan II experiment. Ambats, I.; Ayres, D.; Courant, H.; DasGupta, U.; Allison, W.; Barr, G.; Alner, J.; Cockerill, D.; Benjamin, D.; Kafka, T. (Argonne National Lab., IL (USA); Minnesota Univ., Minneapolis (USA); Oxford Univ. (UK); Rutherford Appleton Lab., Chilton (UK); Tufts Univ., Medford, MA (USA)). 1987. Contract W-31109-ENG-38. 4p. (CONF-870855—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011381.

From 20. international cosmic ray conference; Moscow, USSR (2 Aug 1987).

This paper reports on progress in the construction, installation and operation of the Soudan II nucleon decay detector.

43899 **(BNL—39982) A new apparatus for the study of nuclear Bragg scattering.** Siddons, D.P.; Hastings, J.B.; Faigel, G. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 28p. (CONF-870610—8). NTIS, PC A03. File Number DE87012481.

From 5. national synchrotron radiation instrumentation conference; Madison, WI, USA (21 Jun 1987).

A new monochromator system has been constructed which provides an energy resolution of 0.005 eV and an angular divergence of 0.4 arc seconds at an energy of 14.413 keV. In conjunction with a highly perfect crystal of isotopically enriched $^{57}Fe_2O_3$, a beam of nuclear resonant photons was extracted from the synchrotron continuum with signal to noise ratio of 100:1, and an intensity of >2 quanta/sec. 14 refs., 9 figs.

43900 **(CEA-CONF—8769) ASIC for nuclear and scientific instrumentation.** Gallice, P.; Goursky, V.; Hantelle, G.; Kaiser, J.; Schmit, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)). Oct 1986. 7p. (In French). (CONF-8610275—1). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752362.

From National colloquium on covering gate array and standard cell techniques; Grenoble, France (23 Oct 1986).

In addition to a brief description of CAD tools used in our laboratory, which works in close collaboration with industry, this paper describes some ASICs designed for nuclear instrumentation, and presents a design cost evaluation.

43901 **(DOE/ER/03130—263) Study of designs of a calorimeter with improved resolution.** Allen, P.; Brick, D.; Widgoff, M.; Milstene, C.; Palounek, A.; Pless, I.A. (Brown Univ., Providence, RI (USA); Massachusetts Inst. of Tech., Cambridge (USA)). Feb 1987. Contract AC02-76ER03130. 47p. (COO—3130TB-263). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011622.

Monte Carlo calculations of showers initiated by π^- of 10, 50, 100, and 170 GeV, and by e^- of 10, 50 and 100 GeV have been made in calorimeters using liquid argon as active material and Cu, Pb and U as absorbers. The effect on the resolution of intermixing plates of Cu and Pb, and of varying their thickness have been studied. An analytical method of weighting applied to the energy distribution has improved our results in all the configurations studied. The best performances are predicted for an all-Lead/LAr calorimeter or for an interleaved structure of Pb and Cu. Both of these give resolutions of $[\sigma(E)/E] \sim 0.50/\sqrt{E}$, with little dependence on energy.

43902 **(DOE/ER/40310—1) Photon detector for MEGA search for the rare decay mode $\mu i \rightarrow e^+\gamma$: Progress report: [July 15, 1986 through July 15, 1987].** Gagliardi, C.A.; Tribble, R.E. (Texas A and M Univ., College Station (USA). Dept. of Physics). [1987]. Contract FG05-87ER40310. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013898.

The proposed photon detector design consists of five concentric, cylindrical pair spectrometers. Each spectrometer consists of a layer of plastic scintillator, followed by two layers of multiwire proportional chambers (MWPC), and then two layers of drift chambers. Three Pb converter foils were to be used: one between the scintillator and first MWPC, one between the two MWPC's, and one between the second MWPC and the first drift chamber. Last summer we built a prototype MWPC and measured its performance characteristics in the test channel at LAMPF. We also began testing photomultiplier tubes for time resolution and plastic scintillator bars to determine the best material and type of surface finish for our application. In October, 1986, we began upgrading and expanding the Monte Carlo code used to predict the photon detector response. By late fall, these new Monte Carlo studies demonstrated that the detector scheme initially proposed would not provide the photon energy resolution and efficiency required for the experiment. Following an extensive computer study, a new detector geometry was chosen which provides good energy resolution and efficiency, together with sufficient information to do the pattern recognition required to unravel events reliably. Recently, we have been concentrating on the hardware development required to implement the new design. 1 ref., 4 figs.

43903 **(GANIL-P—86-21) Time-zero detector based on microchannel plates and a friable dielectric emitter.** Lukyanov, S.M.; Penionzhkevich, Y.E.; Lewitowicz, M.; Chubarian, C.G.; Bazin, D.; Guillemaud-Mueller, D.; Mueller, A.C.; Saint-Laurent, M.G. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). 1986. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87752354.

A microchannel plate detector is used in time - zero detectors as a fast multiplier of secondary electrons. For high energy reaction products emitters efficient for fission fragment detection are inadequate because of the very low secondary electron emission coefficient. One way to increase the detection efficiency is to use emitters with control of secondary electron emission by means of friable dielectrics. Such a set up is presented together with experimental tests with a heavy ion beam.

43904 **(LA-UR—87-2254) A humidity temperature test on the HLNC [high-level neutron coincidence counter] instrument.** Goldman, A.; Augustson, R.; Karlin, E.W. (Los Alamos National Lab., NM (USA)). Jul 1987. Contract W-7405-ENG-36. 5p. (CONF-870713—51). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013136.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

This paper presents the findings of a laboratory study made to determine the effects of unusual climatic conditions on high-level neutron coincidence counters (HLNCs). The capability of the instrument, when undesirable temperatures and/or humidities are present, the change in count rate as temperature and humidity increase, and the extent of humidity/temperature interaction are examined.

43905 **(N—87-22952) Cosmic ray detectors. Final report.** Gregory, J.C. (Alabama Univ., Huntsville (USA)). Feb 1987. 29p. (NASA-CR—179086; NAS—1.26:179086). NTIS, PC A03/MF A01.

Work on the MSFC emulsion laboratory microscopes in which mechanical modifications previously made were verified is reviewed, as is a design study of a large area hybrid electronic/emulsion chamber balloon flight detector system. This design is built upon the experience obtained with the highly successful MSFC/UAH hybrid instrument flown by the JACEE consortium. The design included overall system design and specification, design and fabrication of a prototype large light diffusion for Cerenkov charge detector or scintillator, design of a multiwire proportional counter array and design of the gondola or flight support system.

43906 **(NBSIR—87-3548) Calculated response of a 5.5 x 5.5 cm high-purity Ge detector to gamma rays with energies up to 20 MeV.** Seltzer, S.M. (National Bureau of Standards, Washington, DC (USA). Center for Radiation Research). Apr 1987. Contract AI05-86ER60390. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013947.

Monte Carlo calculations have been done of the energy and angular response of a 5.5 x 5.5 cm, high-purity Ge detector, for gamma rays incident with energies from 0.1 to 20 MeV. Results are given for the absolute probabilities of total energy absorption and of single and double annihilation escape, which relate the areas of the peaks in the measured pulse-height distribution to the intensities of incident gamma-ray lines.

43907 **(RISO-M—2637) Measurements of environmental gamma-ray spectra using a multi-element TL dosemeter.** Furuta, Sadaaki; Boetter-Jensen, L.; Nielsen S.P. (Risoe National Lab., Roskilde (Denmark)). Dec 1986. 59p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87752410.

A method to estimate the energy distribution and dose of environmental gamma radiation was developed using a multielement TL dosemeter. Experimentally obtained energy responses from a multi-element TL dosemeter with different kinds of filters were used to calculate the energy distribution and related dose by the SAND-II computer code. The code was originally developed to estimate the neutron flux using a multiple foil activation method. Measurements were made at several locations with the multi-ele-

ment TL dosemeter and comparisons were made with results from a NaI(Tl) scintillation detector and a high-pressure ionization chamber. 25 refs.

43908 (SAND—86-2268C) Filter-fluorescer measurement of low-voltage simulator x-ray energy spectra. Baldwin, G.T.; Craven, R.E. (Sandia National Labs., Albuquerque, NM (USA)). 29 Jul 1987. Contract AC04-76DP00789. 20p. (CONF-870183—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013069.

From 2. simulation fidelity workshop; White Oak, MD, USA (27 Jan 1987).

The filter-fluorescer method for measuring x-ray energy spectra is described. The method uses an eight-channel instrument to measure x-ray spectra at the Maxwell Laboratories' Modular Bremsstrahlung Source (MBS) and the Physics International Pulserad 737. Results agree reasonably well with calculated predictions of the spectra.

43909 Accelerator-based mass spectrometry of methane. Fowler, M.M.; Lysaght, P.; Wilhelmy, J.B. (Los Alamos National Lab., NM). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **24/25**: No. 2, 672-675(Apr 1987). (CONF-861114—). Contract W-7405-ENG-36.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Accelerator-based Mass Spectrometric (AMS) methods have not been generally applied to the analysis of molecular species because of difficulties with ion sources and the fact that tandem accelerators are not generally applicable. A method has been developed to measure the abundance of fully deuterated methanes, $^{13}CD_4$ and $^{12}CD_4$, in normal methane by using AMS. A low-energy electron bombardment ion source has been coupled to a single-ended electrostatic accelerator to produce positively charged molecular ions. The ions are accelerated, mass selected, and then dissociated into fragments that are detected by nuclear particle detection methods. In this way information about the composition of the original molecule, as well as the mass, is obtained. Measurements on natural neon, $^{12}CH_4$, $^{13}CD_4$, and $^{13}CD_4$ have been made, and new approaches to the stabilization of accelerator voltage and isotopic abundance calibration are presented. Possible applications for analysis of other molecules not easily measured with conventional AMS are considered.

43910 Intense lithium ion beam diagnostic using the inverse nuclear reaction D(^{7}Li,n)^{8}Be. Leeper, R.J.; Kim, K.H.; Hebron, D.E.; Wing, N.D.; Norbeck, E. (Sandia National Labs., Albuquerque, NM; Iowa Univ., Iowa City). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **24/25**: No. 2, 695-697(Apr 1987). (CONF-861114—). Contract AC04-76DP00789.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

The decision to employ high voltage lithium ion beams on the 100 TW PBFA-II accelerator has prompted the investigation of using the inverse nuclear reaction D(^{7}Li,n)^{8}Be as an intense beam diagnostic. The diagnostic scheme operates by utilizing the high energy neutrons that are emitted from the D(^{7}Li,n)^{8}Be reaction when a ^{7}Li beam is incident upon a target containing deuterons. These high energy neutrons can in turn induce the ^{63}CU(n,2n)^{62}Cu(β^+) reaction. The amount of 9.74 min ^{62}Cu activity formed can then be measured and related to the total number of ^{7}Li in the beam. The results of calibration runs using ^{7}Li beams accelerated to energies from 1 to 32 MeV are summarized.

43911 Ion-induced X-ray studies with a high luminosity von Hamos crystal spectrometer. Vane, C.R.; Raman, S.; Smith, M.; Heard, J.; Walkiewicz, T. (Oak Ridge National Lab., TN; Yale Univ., New Haven, CT; Edinboro Univ., PA). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **24/25**: No. 1, 59-63(Apr 1987). (CONF-861114—). Contract AC05-84OR21400.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

A high-resolution, high-efficiency, von Hamos geometry, Bragg crystal X-ray spectrometer has been developed and mounted on a beamline at the Holifield Heavy Ion Research Facility at the Oak Ridge National Laboratory. Measurements have been made of K and L X-rays emitted from a variety of targets and projectiles. Instrument performance characteristics are reported here along with spectra from fast projectile ions and very low intensity target emission - areas of measurement for which this spectrometer is especially suitable.

43912 Measurement of the gravitational acceleration of the antiproton: an experimental overview. Jarmie, N. (Los Alamos National Lab., NM). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **24/25**: No. 1, 437-441(Apr 1987). (CONF-861114—). Contract W-7405-ENG-36.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

An ambitious experiment is being developed to measure the force of the antiproton due to the gravitational field of the earth. The technique consists in obtaining antiprotons of the lowest energy possible form the LEAR facility at CERN, decelerating them further in an external beam line, trapping and cooling them to ultra low energy, and measuring their gravitational acceleration by time-of-flight methods. The experiment has been granted CERN approval (PS-200). Present plans and initial development efforts are described.

43913 Crystal blocking in heavy ion reactions. Gomez del Campo, J. (Oak Ridge National Lab., TN). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **24/25**: No. 1, 447-453(Apr 1987). (CONF-861114—). Contract AC05-84OR21400.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

The crystal blocking technique for measuring short lifetimes (10^{-18} s) was developed during the 1960s from the study of the channeling effect. Early blocking lifetime measurements involved light ion resonance reactions yielding typical lifetime values of the order of 10^{-17} s. Recently, studies on heavy-ion induced fission and fusion have extended the technique into the 10^{-18} to 10^{-19} s scale. In this work measurements of fusion for ^{16}O+Ge are presented for bombarding energies around 8 MeV/nucleon. Also measurements of the projectile fragmentation of 44 MeV/ nucleon ^{40}Ar+Ge are discussed. In all reactions studied the presence of particle evaporation is the dominant mechanism that determines the reaction times of $\simeq 10^{-18}$ s measured with the blocking technique.

43914 The new central drift chamber for the MARK II at SLC. Bartelt, J.E. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA 94305). pp 1467-1469 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—). Contract AC03-76SF00515.

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

A new central drift chamber for the MARK II detector is used at the new SLAC Linear Collider (SLC). The design of the chamber is based on a multi-sense-wire cell of the jet chamber type. In addition to drift-time measurements, pulse-height measurements from the sense wires provide electron-hadron separation by dE/dx. The chamber test at operation PEP before the move to the SLC. The design and construction are described, and measurements from the new chamber are presented.

43915 **Recent progress in Cerenkov ring imaging for the SLD experiment.** Ashford, V.; Bienz, T.; Bird, F.; Gaillard, M.; Hallewell, G.; Leith, D.; McShurley, D.; Nuttall, A.; Oxoby, G.; Ratcliff, B. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA 94305). pp 1470-1475 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—). Contract AC03-76SF00515.

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

Results of recent beam tests of a physics prototype Cerenkov Ring Imaging Detector (CRID) for the SLD experiment at the SLAC Linear Collider (SLC) are presented. The system includes both liquid (C/sub 6/F/sub 14/) and gas (isobutane) radiators and an 80 cm long Time Projection Chamber (TPC) with a gaseous TMAE (Tetrakis-Dimethylamino-Ethylene) photocathode and charge division readout of proportional wires. Handling of TMAE and development of a gas delivery system are discussed. Design considerations for the construction of the TPC anode planes are presented along with measurements of the multiplicity of detected Cerenkov photons, of Cernkov angles, and the resolution with both radiators. The particle identification capability of this detector is discussed.

43916 **High-spin gamma-ray spectroscopy.** Diamond, R.M. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA 94720). pp 9-24 of Nuclear spectroscopy and nuclear reactions. Ejiri, H.; Fukuda, T. Teaneck, NJ; World Scientific Pub. Co. (1984). (CONF-840312—).

From Conference on the changing structure of the world oil industry; Guildford, UK (22 Mar 1984).

The author discusses how nuclei can carry angular momentum by single-particle alignments and by collective motion, as has been well illustrated in discrete-line spectroscopy. From continuum γ-ray studies in still higher spin regions, it appears that these modes both continue. In favorable cases in rare-earth nuclei, particle alignments from the valence shell separate from proton alignments from the next higher shell. A new generation of Compton-suppressed Ge detector arrays greatly enhance high-spin studies, both continuum and discrete-line.

4402 Radiation Effects On Instrument Components, Instruments, Or Electronic Systems

REFER ALSO TO CITATION(S) 43958

43917 **(AD-P—005281/1/XAB) Nuclear-hardfibre-optic-cable assemblies for tactical systems.** Bedgood, M.A.; Grey, A.; Irven, J.; Ramsay, M.M.; Titchmarsh, J.G. (STC Technology Ltd., Harlow (UK)). Nov 1986. 9p. NTIS, PC A02/MF A01.

This article is from Proceedings of the International Wire and Cable Symposium (35th) Held in Reno, Nevada on 18-20 November 1986, AD-A180 828, 517-525.

A nuclear-hard-fibre optic cable assembly has been developed for the US Army FOTS(LH) programme on behalf of CECOM, Fort Monmouth. The fibre is based on a standard 50/125 micrometer graded index design, but with very careful modification and control of glass compositions and fibre-processing parameters in order to achieve nuclear hardness over the full environmental ranges specified. The cable utilises a simple squad design, comprising two fibres plus two fillers, a Kevlar 49 yarn strength member and flame-retardant 5.5-mm O.D extruded sheath and is produced in a single operation with purpose-built equipment. The fibre-optic-cable assembly is completed with expanded beam hermaphrodite connectors. An extensive qualification test programme has shown the nuclear, optical, and mechanical requirements of the FOTS(LH) specification to be met over the full environmental temperature range -46 to +71 C.

4403 Miscellaneous Instruments

REFER ALSO TO CITATION(S) 43312, 43550, 43620, 43660, 43714, 43795, 43950, 44418

43918 **(AD-A—180848/4/XAB) Space surveillance application potential of Schottky barrier IR sensors. Technical report.** Cantella, M.J. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 9 Apr 1987. 42p. (TR—772). NTIS, PC A03/MF A01.

Schottky-barrier IR detection is based on the principle of internal photoemission at the surface between a Si substrate and a deposited metal. In a multi-element focal plane array (FPA), this phenomenon provides very high pixel-to-pixel uniformity, so the requirement for corrective signal processing is minimal. The use of standard silicon design and fabrication techniques simplifies detector readout and multiplexing functions and permits practical realization of sensors that contain very large staring focal planes. This report summarizes the status of FPA and camera development and includes typical imagery. For surveillance applications, the high sensitivity obtainable with these large staring arrays offers both signature and background phenomenology opportunities in the medium wavelength (MWIR) band which could not be exploited previously with scanning-type sensors. Examples of predicted surveillance sensor performance include (1) a near-term ground-based system for Day/Night detection of low-altitude space objects and (2) a future space-borne system for space missions. It is concluded that significant potential exists for future application of this technology.

43919 **(BNL—40058) Attributes measurements by calorimetry in 15 to 30 minutes.** Fiarman, S.; Perry, R.B. (Brookhaven National Lab., Upton, NY (USA); Argonne National Lab., IL (USA)). 1987. Contract AC02-76CH00016. 6p. (CONF-870713—48). NTIS, PC A02. File Number DE87013310.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

An analysis of the early portion of the power-history data collected with both of the IAEA's air-cooled bulk calorimeters has demonstrated that such calorimeters can measure the power from preheated containers of plutonium oxide with an accuracy of 2 to 5% in 15 to 30 minutes. Material accountancy at plutonium facilities has a need for such a capability for measurement of Pu scrap. Also, the International Atomic Energy Agency (IAEA) could use just two calorimeters and a gamma-ray assay system for reliable variables and attributes measurements of plutonium mass during a two-day physical-inventory verification (PIV) at a mixed-oxide (MOX) fuel-fabrication facility. The assay results would be free of the concerns about sample moisture, impurities, and geometry that previously have limited the accuracy of assays based on neutron measurements.

43920 **(CONF-860807—4) Laser-based secondary neutral mass spectroscopy: Useful yield and sensitivity.** Young, C.E.; Pellin, M.J.; Calaway, W.F.; Joergensen, B.; Schweitzer, E.L.; Gruen, D.M. (Argonne National Lab., IL (USA); Odense Univ. (Denmark). Fysisk Inst.). 1986. Contract W-31109-ENG-38. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011464.

From 6. international workshop on inelastic ion surface collisions; Argonne, IL, USA (25 Aug 1986).

A variety of problems exist in order to optimally apply resonance ionization spectroscopy (RIS) to the detection of sputtered neutral atoms, however. Several of these problems and their solutions are examined in this paper. First, the possible useful yields obtainable and the dependence of useful yield on various laser parameters for this type of sputtered neutral mass spectrometer (SNMS) are considered. Second, the choice of a mass spectrometer and its effect on the instrumental useful yield is explored in light of the unique ionization region for laser based SNMS. Finally a brief description of noise sources and their effect on the instrumental sensitivity is discussed. 33 refs., 12 figs.

43921 **(CONF-8705165—1) Electron sputtering in the analytical electron microscope: Calculations and experimental data.** Zaluzec, N.J.; Mansfield, J.F. (Argonne National Lab., IL (USA)). Mar 1987. Contract W-31109-ENG-38. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011457.

From Workshop on intermediate voltage microscopy and its application to materials science; Ottawa, Canada (26 May 1987).

The environment of the electron microscope is particularly severe when one considers the energy deposited in a specimen during typical experimental conditions. Conventional imaging experiments tend to employ electron current densities ranging from ~0.1 to 1 A/cm^2 while during microanalysis conditions probe current densities can range from 10 to values as high as 10^5 A/cm^2. At 100 kV this corresponds to power densities from 100 Kilowatts/cm^2 to 10^4 Megawatts/cm^2. These energy deposition rates can result in electron irradiation damage which can substantially alter the structure and composition of a specimen through either ionization damage in organics or by displacement damage in inorganics and/or combinations thereof. For the most part materials scientists operating an analytical electron microscope (AEM) in the 100 to 200 kV regime studying metallic and/or ceramic specimens have been spared the need to consider either of these effects as their specimens have tended to be sufficiently resilient. However, the advent of the new medium voltage microscopes operating in the 300 to 400 kV regime with high brightness guns and clean or ultra-high vacuum systems has necessitated a reevaluation of the effects of higher voltage operation in light of the destructive nature of the electron beam particularly under microanalysis conditions.

43922 **(EUR—10774-EN) Experimental data for the determination of 100 mm orifice meter discharge coefficients under different installation conditions (European programme).** Hobbs, J.M.; Sattary, J.A. (Commission of the European Communities, Luxembourg. Directorate General Information Market and Innovation; National Engineering Lab., East Kilbride (UK)). 1987. 190p. Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities.

BCR information. Applied metrology.

This report presents the results of calibrations of 'thin' 100 mm orifice plates of diameter ratios 0.57 and 0.75 made under various installation conditions with and without the use of flow straighteners. Data were obtained by NEL using air and water and by Gasunie and Gaz de France using natural gas. These investigations form part of the EEC programme which has the objective of verifying or improving the values predicted for the discharge coefficient of orifice plate flowmeters.

43923 **(LBL—23664) Fuel cell oxygen sensor for trace oxygen analysis.** Leone, A.; Otvos, J.W.; Calvin, M. (Lawrence Berkeley Lab., CA (USA)). Jun 1987. Contract AC03-76SF00098. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013962.

For photochemical studies of oxygen generation we have built an on-stream, gas phase oxygen detector based on a commercially available sensor, which has a detection limit of .002 Torr. If oxygen is generated in the solution phase, we can take account of the time-constant of the vapor-liquid equilibration to obtain accurate time course data for oxygen production.

43924 **(N—87-22817) Fast ion mass spectrometry and charged particle spectrography investigations of transverse ion acceleration and beam-plasma interactions. Final report.** Gibson, W.C.; Tomlinson, W.M.; Marshall, J.A. (Southwest Research Inst., San Antonio, TX (USA)). Jan 1987. 104p. (NASA-CR—168348; NAS—1.26:168348). NTIS, PC A06/MF A01.

Ion acceleration transverse to the magnetic field in the topside ionosphere was investigated. Transverse acceleration is believed to be responsible for the upward-moving conical ion distributions commonly observed along auroral field lines at altitudes from several hundred to several thousand kilometers. Of primary concern in this investigation is the extent of these conic events in space and time. Theoretical predictions indicate very rapid initial heating rates, depending on the ion species. These same theories predict that the events will occur within a narrow vertical region of only a few hundred kilometers. Thus an instrument with very high spatial and temporal resolution was required; further, since different heating rates were predicted for different ions, it was necessary to obtain composition as well as velocity space distributions. The fast ion mass spectrometer (FIMS) was designed to meet these criteria. This instrument and its operation is discussed.

43925 (N—87-23341, pp 3) **Melting of troilite at high pressure in a diamond cell by laser heating.** Bassett, W.A.; Weathers, M.S. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

A system for measuring melting temperatures at high pressures is described. The sample is heated with radiation from a YAG laser. The beam is reflected downward through a microscope objective, through the upper diamond anvil, and focused onto the sample. Hense, intense heating is produced only at the sample and not within the diamond anvils. A vidicon system is used to observe the sample during heating. Incandescent light from the heated sample passes back through the objective lens into a grating spectrometer. The spectrum of the incandescent light is received by the photodiode array and stored in the multichannel analyzer. These data can then be transferred to floppy disk for analysis. A curve fitting program is used to compare the spectra with standard blackbody curves and to determine the temperature. Pressure is measured by the ruby fluorescence method. The system was used to study the melting behavior of natural troilite (FeS).

43926 **(SAND—87-0931C) Fabrication of standardized piezoelectric polymer shock gauges by the Bauer method.** Fogelson, D.J.; Lee, L.M.; Gilbert, D.W.; Conley, W.R.; Graham, R.A.; Reed, R.P.; Bauer, F. (Sandia National Labs., Albuquerque, NM (USA); Ktech Corp., Albuquerque, NM (USA); Institut Franco-Allemand de Recherches de Saint-Louis, 68 (France)). 1987. Contract AC04-76DP00789. 4p. (CONF-870753—29). NTIS, PC A02/MF A01; GPO Dep. File Number DE87012738.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

A cooperative program has been initiated among our laboratories to provide a reproducible PVF_2 polymer film for use as a gauge under shock-compression loading. The material source and electrical treatment are based on prior work of Bauer. The primary effort of the program focused on developing electroding and poling capabilities in the US. The Bauer electrical poling method is the only known process which provides the necessary reproducibility for shock applications. It is now possible to produce gauges of excellent quality in the US.

43927 **(SAND—87-1238) The Six-Port Measurement system implemented at Sandia National Laboratories.** Moyer, R.D. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1987. Contract AC04-76DP00789. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012341.

This paper surveys the history and usage of Six-Port Reflectometer systems in the Primary Standards Laboratory of Sandia National Laboratories and in the Metrology Laboratory of Bendix Aerospace Sector of Allied Corporation in Kansas City. The text is comprised of the outline of the talk and the viewjgraphs used in conjunction with it.

43928 **(SAND—87-1379) Anechoic Chamber test of the Electromagnetic Measurement System ground test unit.** Stevenson, L.E.; Scott, L.D.; Oakes, E.T. (Sandia National Labs., Albuquerque, NM (USA)). 10 Apr 1987. Contract AC04-76DP00789. 50p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012998.

The Electromagnetic Measurement System (EMMS) will acquire data on electromagnetic (EM) environments at key weapon locations on various aircraft certified for nuclear weapons. The high-frequency ground unit of the EMMS consists of an instrumented B61 bomb case that will measure (with current probes) the

localized current density resulting from an applied EM field. For this portion of the EMMS, the first system test was performed in the Anechoic Chamber Facility at Sandia National Laboratories, Albuquerque, New Mexico. The EMMS pod was subjected to EM radiation at microwave frequencies of 1, 3, and 10 GHz. At each frequency, the EMMS pod was rotated at many positions relative to the microwave source so that the individual current probes were exposed to a direct line-of-sight illumination. The variations between the measured and calculated electric fields for the current probes with direct illumination by the EM source are within a few db. The results obtained from the anechoic test were better than expected and verify that the high frequency ground portion of the EMMS will accurately measure the EM environments for which it was designed.

43929 **Measurements of lateral offset power losses in step-index optical fibers scanning point sources.** Dowell, L.J.; Gillies, G.T.; Allison, S.W. (Univ. of Virginia, Dept. of Nuclear Engineering and Engineering Physics, Jesse W. Beams Lab. of Physics, Charlottesville, VA 22901). *Optical Engineering;* **26**: No. 6, 547(Jun 1987).

The authors report the results of an experimental study of optical power losses due to lateral offset of the input aperture of a step-index optical fiber used to scan a point source. Data were taken with hard-clad silica and plastic-clad silica fibers having core diameters ranging from 200 to 1000 μm. These results will be useful in establishing alignment criteria for the optical components used in the laser-based remote thermometry research program.

43930 **Fiber optic pulsed laser delivery for remote measurements.** Allison, S.W.; Cates, M.R.; Gillies, G.T.; Noel, B.W. (Martin Marietta Energy Systems, Inc., Oak Ridge Gaseous Diffusion Plant, Enrichment Technology Applications Center, MS-280, Building K-1220, P.O. Box P, Oak Ridge, TN 37831). *Optical Engineering;* **26**: No. 6, 538-546(Jun 1987). Contract AC05-84OR21400.

The results of a research program on the delivery of high-peak power laser light via fiber optics are presented. The authors discuss the influence of the host medium and the optical signals on the choice of fiber materials, complemented by a consideration of the measurement environments effects on the quality of the data. They pay close attention to the choice of input/outpout beam/fiber coupling optics, nonlinear processes in the core, measurement system noise, and baseline drifts. Useful discussions of pulsed laser damage to optical fibers and data for optimization of a given fiber optic laser beam delivery system are given.

45 EXPLOSIONS AND EXPLOSIVES

4501 Chemical

REFER ALSO TO CITATION(S) 43957, 43984

43931 **(AD—919472/1/XAB) Evaluation of alternate high-explosive simulation-technique explosives. Final report, March 1967-December 1973.** Baum, N.P.; Bell, K. (New Mexico Univ., Albuquerque (USA). Eric H. Wang Civil Engineering Research Facility). May 1974. 35p. NTIS, PC A03/MF A01.

Distribution limitation now removed.

An experimental evaluation of three explosives was undertaken to determine their suitability as a driver for High-Explosive Simulation Technique (HEST). The motivation for this study was an attempt to establish a more cost-effective method of simulating the effect of an airblast caused by a nuclear detonation. In line with this, the criteria used for the evaluation were changes in physical characteristics during storage, detonation velocity, detonation transfer, initiation requirements, overpressures, and installed cost as compared to the presently used detonating cord. The testing conducted in this effort yielded the conclusion that two of the explosives were unsuitable for use on HEST. However, ammonium nitrate/fuel oil (ANFO), because of its extremely low cost and somewhat favorable characteristics, merits further investigation.

43932 **(AD-B—009650/3/XAB) Airblast calculations for advanced missile system (MX) support. Final report.** Needham, C.E.; Westmoreland, C. (Air Force Weapons Lab., Kirtland AFB, NM (USA)). Feb 1976. 123p. (AFWL-TR—75-297). NTIS, PC A06/MF A01.

Distribution limitation now removed.

Theoretical calculations of the air blast resulting from a 1-megaton (MT) detonation were conducted. The calculations include the free air environment and propagation through a smooth tunnel with various inlet pressures. One calculation also included corrugated walls. The various results are compared.

43933 **(AD-B—013123/5/XAB) HARD PAM I test series test and instrumentation plans. Volume 1. Test plan. Final report.** Doran, J. (General Electric Co., Santa Barbara, CA (USA). TEMPO). Dec 1975. 113p. NTIS, PC A06/MF A01.

Distribution limitation now removed.

The objectives, test configurations, and instrumentation implementation of the HARD PAN I test series are presented in three voluumes. Volume I describes the high-explosive test events (5 major and 13 calibration events) performed to obtain experimental measurements of the shock environment in the vicinity of a test structure in a layered geology due to a simulated near-surface nuclear detonation. The test geology was clay over interbedded limestone and shale. Structure/medium interaction (SMI) Data obtained in the test series is to be used in development of prediction codes for use in analyses relating to facility design, modification, and hardness validation and/or assessment. The beam-loaded explosive simulation technique (BLEST), a new technique for high-explosive simulation of nuclear-detonation effects, is described. The first use of BLEST was in the HARD PAN I series where it augmented the more-precise HEST USED TO PROVIDE DIRECT AIRBLAST LOADING, AND INCREASED TOTAL SIMULATION TIMES AT ACCEPTABLE ADDITIONAL COST. Volume I also includes specific operational plans (safety, communications, security) and data-analysis requirements. Volume II (Appendix P) describes the instrumentation systems used to obtain motion, stress, and strain data from free-field and structure locations in the first three major events and the calibration events. Measurements lists are included. Volume III (Appendix P, Continued) describes the instrumenting of the final two major events and lists all measurements.

43934 **(AD-B—016229/7/XAB) AFWL (Air Force Weapons Laboratory) HULL (Hydrodynamics Unlimited) calculations of air blast over a dam slope. Final report.** Fry, M.A.; Needham, C.E.; Stucker, M.; Chambers, B.S.; Ganong, G.P. (Air Force Weapons Lab., Kirtland AFB, NM (USA)). Oct 1976. 125p. (AFWL-TR—76-154). NTIS, PC A06/MF A01.

Distribution limitation now removed.

This laboratory performed Hydrodynamics Unlimited (HULL) calculations of the air blast over a dam for two yields and two pressure regions. A 5th calculation included a rigid blockhouse at the foot of the dam. Although the shielding effect of the dam reduced the incident blast wave overpressure, reflection of the shock from the valley floor raised the peak overpressure up to at least 40% of the free air value. In almost every case, the overpressure impulses near the foot of the dam were greater than or equal to free air values. The rigid blockhouse experienced the most severe overpressure environments. The assumption of a 50-psi hard blockhouse is reasonable. During collapse of the blockhouse, it appears to be rigid to the air flow, since it responds slowly to the rapid air blast. Although there may be other reasons to detonate the weapon on the surface of the reservoir, the best way to destroy the blockhouse and any related structures with air blast, probably would be to detonate the device downstream of the blockhouse.

43935 **(AD-B—016691/8/XAB) HARD PAN I test series - test and instrumentation plans. Volume II. Instrumentation plan. Final report.** McGrath, S.G. (General Electric Co., Albuquerque, NM (USA). TEMPO). Nov 1976. 195p. NTIS, PC A09/MF A01.

See also Volume 3, AD-B016 692L; Distribution limitation now removed.

This Appendix describes the instrumentation of the HARD PAN I series of high-explosive tests conducted near Trading Post, Kansas in the period October 1974 to December 1975. The HARD PAN series consisted of a total of 17 events, four of which were major tests. The first two major events (HP I-1 and HP I-2A) were separated from the final two major events (HP I-2B and HP I-3) by several sets of calibration events (SCAL, ICAL, HBL and SICAL) to aid in the final design of the main event (HP I-3). With the exception of two of the calibration events extensive instrumentation was employed to measure ground and structure motions, oil stress, structure/medium stresses, structural strains, and blast pressure. The Appendix is in eight parts and each, except for Part 8, addresses an individual major event or a set of similar calibration events. Part 8 is concerned with instrumentation topics generally common to all of the tests.

43936 **(AD-B—016692/6/XAB) HARD PAN I test series - test and instrumentation plans. Volume 3. Instrumentation plan continued. Final report.** McGrath, S.G. (General Electric Co., Albuquerque, NM (USA). TEMPO). Nov 1976. 222p. NTIS, PC A10/MF A01.

See also Volume 1, AD-B013 123L; Distribution limitation now removed.

Contents include: test site layout; coordinate systems; instrumentation; channel-record assignments; measurement identification; transducers; canister placement in slant hole; free-field-blast pressure-gage installations; and connection diagrams.

43937 **(AD-B—017323/7/XAB) Cylindrical in-situ tests at selected nuclear and high-explosive test sites. Final report.** (Air Force Weapons Lab., Kirtland AFB, NM (USA)). Feb 1977. 223p. (AFWL-TR—76-209). NTIS, PC A10/MF A01.

Distribution limitation now removed.

The development of high-confidence ground-shock prediction techniques using computer simulation of nuclear bursts over or in real geologic materials is essential for adequate design and evaluation of present and future hardened land-based systems. In the past, the calculational technique developed and used in these studies has relied upon material constitutive models developed from laboratory tests of material samples. Crucial to the success of this theoretical ground-shock prediction program is a clear verification of the ability of the soil modeling and calculational technique to accurately reproduce ground motions generated by scaled high-explosive (HE) detonations in geologies of direct interest to DOD systems. Substantial discrepancies between calculated and observed ground motions were noted. These are attributable primarily to inadequacies in the laboratory-based soil and rock material models. To overcome some of the shortcomings of the laboratory-based modeling techniques, an in situ material property test was developed by the Air Force Weapons Laboratory (AFWL). The Cylindrical In-Situ Test (CIST) technique permits measurement of the dynamic response of geological materials to a cylindrically symmetric high-explosive shock input yielding data from which in-situ material properties may be determined for a range of initial loading stresses. Models based on CIST data resulted in substantially improved agreement between calculated and observed data. Data from CIST 2 conducted in 1972, CIST 10 conducted in 1974, CIST 15 conducted in 1975, and CIST 16 conducted in 1976 are included in this report.

43938 **(AD-B—019843/2/XAB) AIRCRAFT SHELTER-DICE throw data report. Final report.** Webster, H.T.; Bradshaw, J.C.; Swartz, L.M. (Air Force Weapons Lab., Kirtland AFB, NM (USA)). Mar 1977. 446p. (AFWL-TR—77-1). NTIS, PC A19/MF A01.

Distribution limitation now removed.

This report presents the data for the AIRCRAFT SHELTER-DICE THROW Test. This test was a part of the DICE THROW Series conducted by Field Command Defense Nuclear Agency at White Sands Missile Range, New Mexico. The test was conducted on 6 October 1976 at 0800 hours. The test subjected a scaled model of a proposed aircraft shelter closure and three scaled models of aircraft shelters to the airblast effects from the detonation of 570,000kg (630 tons) of ammonium nitrate/fuel oil (AN/FO) to evaluate the blast response of the closure and shelters.

43939 **(AD-B—020287/9/XAB) Post-test, two-dimensional, free-field calculation of HARD PAN I, Event 3: Calculation HPI-3.4. Final report.** Baird, G.T.; Rudeen, D.K.; Higgins, C.J. (New Mexico Univ., Albuquerque (USA). Eric H. Wang Civil Engineering Research Facility). Jun 1977. 78p. (CERF-DP/EM—8). NTIS, PC A05/MF A01.

Distribution limitation now removed.

The results of the pretest calculations of HARD PAN I Event 3 were analyzed and compared with experimental data to evaluate the accuracy of the input (pressure functions, geology, material properties) and output (computed velocity waveforms). Seismic velocities for a recommended geology were developed from contours of experimental times-of-arrival of first motion and incorporated into new material properties as the initial loading and unloading slope of the hydrostat. Lock-up strain values and shear-failure envelopes were consistent with previous material properties and laboratory test results. The analysis indicated that the BLEST pressure function was satisfactorily modeled based on the impulse delivered to the soil. However, a new HEST pressure function which would accurately reflect the experimental pressure/time history was developed for the post-test calculations. Post-test calculation HPI-3.4 was performed with the new input and compared with experimental data. This comparison indicated fairly good agreement. Adjustment factors to modify the data for input to the Three-Dimensional, Structure/Media Interaction (SMI3D) Code were then recommended.

43940 **(AD-B—026217/0/XAB) Effects of nonideal surface on airblast from one-megaton yields. Final report.** Fry, M.A.; Ganong, G.P.; Aubrey, J.W. (Air Force Weapons Lab., Kirtland AFB, NM (USA)). Feb 1978. 126p. (AFWL-TR—77-179). NTIS, PC A07/MF A01.

Distribution limitation now removed.

Hull hydrodynamic computer-code calculations were performed of 1-MT surface bursts and air bursts at 500, 750, and 1000 feet heights of burst (HOB). Calculations were performed for both an ideal ground surface and a nonideal surface (with a hot layer of air above the ground surface). The properties of the hot layers of air were defined by a fit to sound-speed data from several Nevada events. The nonideal surface burst began to develop a precursor at 1000 psi. All air bursts showed strong precursor effects. The heights of burst were low enough to produce hydrodynamic precursors, due to jetting above the ground, even without a hot layer of air. The addition of a hot layer increased the extent, effects, and duration of the precursor.

43941 **(LA-UR—87-928) Real time analysis of detonation products.** Blais, N.C.; Greiner, R.; Fernandez, W. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 8p. (CONF-871040—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87007453.

From International symposium on pyrotechnics and explosives; Beijing, China (12 Oct 1987).

We have determined the mass spectrum and the time evolution of the freely expanding products of highly shocked and detonating substances. So far we have studied pentaerythritol tetranitrate (PETN), hexanitrostilbene (HNS), cyclotrimethylene trinitramine (RDX) and nitric oxide (NO). For the case of NO, we find that N_2 and O_2 are important products of the detonation. Other reaction products are N_2O and NO_2, some of which arise from secondary reactions between O_2 and unreacted NO. The other explosives give rise to a rich spectrum that includes many radicals not found in equilibrium spectra. Comparative spectra for two of these common explosives, RDX and HNS, are presented. 4 refs., 3 figs., 1 tab.

43942 **(SAND—86-2339C) Microstructural effects in shock initiation of granular explosives.** Setchell, R.E. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 21p. (CONF-871040—9). NTIS, PC A02/MF A01; GPO Dep. File Number DE87011282.

From International symposium on pyrotechnics and explosives; Beijing, China (12 Oct 1987).

The shock sensitivity of explosives having identical chemical compositions and densities can be very different if they differ significantly in their microstructural characteristics. In the current

work, the explosive hexanitrostilbene (HNS) is used to examine the effects of microstructural characteristics on shock initiation processes. Initial powders having three distinct grain-size distributions are used to press binderless pellets at a common density that is 92% of crystal density. The effects of the pressing operations are shown in grain-size distributions found for powders recovered from dispersed pellets. Planar impact techniques are used to generate sustained shock waves at pressures from 2.5 to 3.4 GPa in each type of HNS material. Laser velocity interferometry is used to observe the evolution of these waves propagating in each material. In addition, two methods for observing visible emission from the shock-compressed explosives are used to provide more sensitive indicators of chemical reactivity. The results clearly show that the three types of HNS have fundamentally different shock initiation behaviors under the conditions examined. 24 refs., 8 figs.

43943 **(UCRL—95443) Optically time-resolved detonation break out.** Bahl, K.; Von Holle, W.; Lee, R.S. (Lawrence Livermore National Lab., CA (USA)). 20 May 1987. Contract W-7405-ENG-48. 6p. (CONF-871040—8). NTIS, PC A02/MF A01; GPO Dep. File Number DE87010340.

From International symposium on pyrotechnics and explosives; Beijing, China (12 Oct 1987).

We have made optical measurements of detonation arrival at high explosive free surfaces in air, vacuum and in contact with potassium chloride and sodium chloride single crystals. Fast, time resolved measurements with an electronic streak camera operating at 100 mm/μs reveal interesting luminosity histories. Bare surfaces yield sharp features which allow time of arrival measurements accurate to a few nanoseconds. An HMX-containing explosive with a relatively large particle size exhibits a clear inhomogeneity perpendicular to the sweep direction compared to PETN or TATB explosives containing finer particles. The use of electronic streak cameras has extended the range of writing speeds over those of rotating mirror cameras by an order of magnitude. At this Laboratory we have begun to use electronic cameras as a routine diagnostic tool for detonation phenomena. Because of their high speed and sensitivity, they are capable of extremely precise timing measurements, and we have used this feature to develop an improved method for measuring detonation break out. This paper describes this technique and the experiments designed to determine the exact nature of the observed features of the detonation break out. The time-resolved light emission appears to be intimately connected with the detonation reaction zone structure, and there are significant differences between explosives. 4 refs., 4 figs., 1 tab.

43944 **(UCRL—95459) Electric gun studies on an extremely insensitive TATB formulation.** Simpson, R.L.; Helm, F.H.; Kury, J.W. (Lawrence Livermore National Lab., CA (USA)). 9 Apr 1987. Contract W-7405-ENG-48. 8p. (CONF-871040—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008421.

From International symposium on pyrotechnics and explosives; Beijing, China (12 Oct 1987).

An especially insensitive form of TATB (1,3,5-Triamino-2,4,6-Trinitrobenzene) was used to obtain an estimate of a non-reactive Hugoniot point at 35 GPa and shock initiation data at pressures up to 64 GPa. The material was shocked using exploding foil driven flyers. Sample transit times were measured with piezoelectric pins and a radiometer was used to check for reaction. At pressures above 35 GPa some reaction was observed and the sample transit times approximated those calculated with the reactive flow model used for LX-17 (standard TATB/Kel-F 800 formulation). A color temperature of 2950 K was obtained for the reacted material. 7 refs., 4 figs., 3 tabs.

43945 **(UCRL—95461) Shock measurements on explosives in the supra compressive region.** Green, L.; Holmes, N.; Kury, J. (Lawrence Livermore National Lab., CA (USA)). 1 Apr 1987. Contract W-7405-ENG-48. 8p. (CONF-871040—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008423.

From International symposium on pyrotechnics and explosives; Beijing, China (12 Oct 1987).

The velocity of supra-compressive shocks in PETN and LX-14 (94% HMX/6% ESTANE) have been measured using the extinction of the reaction-generated light at free surfaces to signal shock arrival. Additional measurements were made on PETN using pin techniques. A single JWL equation was fit to the results of the supra-compressive experiments on PETN at pressures up to 80 GPa, to the measured C-J pressure, and to cylinder test data. The results are compared with theoretical calculations. 10 refs., 3 figs., 5 tabs.

43946 **(UCRL—95462) Current experimental and theoretical understanding of detonation waves in heterogeneous solid explosives.** Tarver, C.M.; Breithaupt, R.D.; Kury, J.W. (Lawrence Livermore National Lab., CA (USA)). 14 Apr 1987. Contract W-7405-ENG-48. 11p. (CONF-871040—10). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012177.

From International symposium on pyrotechnics and explosives; Beijing, China (12 Oct 1987).

Nanosecond time resolution embedded gauge, laser interferometric, and numerical modeling techniques have been applied to detonating heterogeneous solid explosives based on HMX, TATB, TNT and PETN. These techniques combine to yield an average, one-dimensional ZND profile of the reaction zones and an estimate of the unreacted von Neumann spike state (or a partially reacted state depending on the actual time resolution of the experimental techniques and the actual initial reaction rates). Generally the new results confirm previous measurements of the spike pressure and overall reaction zone length, but they yield much more precise information on the chemical energy release rates under various experimental conditions. The relatively slow process of carbon condensation in HMX detonation is observed following rapid release of most of the chemical energy. In the longer reaction zones of TNT and TATB-based explosives, a rapid exothermic process followed by a slower exothermic process is also observed. 21 refs., 8 figs.

43947 **(UCRL—95483) The effect of RDX particle size on the shock sensitivity of cast PBX formulations: 2, Bimodal compositions.** Moulard, H.; Delclos, A.; Kury, J. (Lawrence Livermore National Lab., CA (USA); Institut Franco-Allemand de Recherches de Saint-Louis, 68 (France); Societe Nationale des Poudres et Explosifs, 91 - Vert-le-Petit (France)). 1 Apr 1987. Contract W-7405-ENG-48. 9p. (CONF-871040—7). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009581.

From International symposium on pyrotechnics and explosives; Beijing, China (12 Oct 1987).

The effect of RDX particle size on the shock sensitivity and detonation velocity of two cast polyurethane-based bimodal RDX formulations has been determined. The shock sensitivity results (wedge test data) have been interpreted using a hydrodynamic code containing a three term ignition and growth model for build-up of detonation. 2 refs., 6 figs., 2 tabs.

43948 **(UCRL—95818) Statistical mechanical theory of condensed explosives.** Ree, F.H.; van Thiel, M. (Lawrence Livermore National Lab., CA (USA)). 22 Apr 1987. Contract W-7405-ENG-48. 9p. (CONF-871040—6). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009137.

From International symposium on pyrotechnics and explosives; Beijing, China (12 Oct 1987).

The goal of our explosive research is to understand the detonation performance of explosives by using fundamental theories of physics and chemistry. The present article describes results of our calculations on PBX-9494, LX-14, PETN, and TNT. 12 refs., 6 figs.

43949 **(UCRL—96803) The use of fiber optics in the determination of temperature and extent of reaction in detonating explosives.** Simpson, R.; Helm, F.; Kury, J. (Lawrence Livermore National Lab., CA (USA)). 8 Jun 1987. Contract W-7405-ENG-48. 7p. (CONF-870584—9). NTIS, PC A02. File Number DE87012632.

From Technical symposium southeast on optics, electro-optics and sensors; Orlando, FL, USA (17 May 1987).

A four-channel fiber optic radiometer has been built to measure the temperature and extent of reaction of a detonation before the shock wave destroys the collection optics. The system is designed to be calibrated both in terms of the relative radiant response and the absolute sensitivity of each channel. Fiber optics

and associated data acquisition electronics allow synchronization of radiometric and pressure transducer signals to under 10 nsec.

4502 Nuclear

REFER ALSO TO CITATION(S) 43237, 43506, 43908, 44225

43950 (AD—914455/1/XAB) Evaluation of Minuteman accelerometer instrumentation. Technical report, August 1971-September 1972. Patel, M.K.; Chazen, D.G. (Air Force Weapons Lab., Kirtland AFB, NM (USA)). Oct 1973. 353p. (AFWL-TR—73-122). NTIS, PC A16/MF A01.

Distribution limitation now removed.

Various tests were performed to determine the capabilities and limits of piezoresistive accelerometers. Macroscopic, static, and dynamic tests were conducted on all accelerometers before and after the environmental tests (electrical, humidity, and temperature). The accelerometers were overranged to check their overrange performance characteristics.

43951 (AD-A—180834/4/XAB) Select bibliography on nuclear winter. McIntosh, L.A. (Pacific-Sierra Research Corp., Los Angeles, CA (USA)). 1 Mar 1987. 30p. (PSR—743). NTIS, PC A03/MF A01.

A 1982 article by P.J. Crutzen and J.W. Birks first suggested that smoke from wildland and urban fires could have a significant impact on the atmosphere. The theory of nuclear winter was first presented at the World after Nuclear War conference held in 1983. Following the conference, articles describing the potential climatic and biological consequences of a global nuclear exchange were published. Most of the nuclear winter literature concentrates on atmospheric and climatic effects. There are also some work that focus on strategic policy, medical, and agricultural effects. A broad spectrum of viewpoints and theories exists in the published literature on nuclear winter. This bibliography reflects those varying viewpoints. This compilation includes works published up to 1 March 1987. Articles from popular magazines and newspapers were omitted. Citations include 129 articles, 21 books, and 54 technical reports. A further reading list composed of 80 sources relevant to the nuclear winter theory is also provided.

43952 (AD-A—180893/0/XAB) Creative use of scenarios. Final report, September 1986-April 1987. Tritten, J.J. (Naval Postgraduate School, Monterey, CA (USA)). 30 Apr 1987. 21p. (NPS—56-87-001). NTIS, PC A02/MF A01.

Surprise and the Single Scenarios is the title of an article by Sir James Cable. The essence of his thesis is that the United Kingdom should not prepare its military with just one contingency in mind. Related theses have been debated for many years; should Soviet military strategy be based upon the doctrinal assumption of quick escalation to nuclear war. Should U.S. nuclear forces be procured with the requirement to survive a well-executed surprise first strike. In considering these and related political-military questions, scenarios are often created to flesh out the concept being considered. For example, military planners in the USSR undoubtedly use alternating scenarios to consider possible courses that armed conflict could take in order that they might assess the impact of short- or long-time scales on nuclear/conventional interactions. Similarly, varying scenarios are used in the U.S. to demonstrate the impact of different threat assumptions on the amount and types of nuclear forces that the U.S. should buy that would guarantee an acceptable level of retaliation. The major point to all this, and this report, is that in order to perform complex political military assessments, political scientists either explicitly or implicitly use operations analysis techniques, including simulations, gaming and scenarios.

43953 (AD-A—180928/4/XAB) Early-time HANE simulation and experiment. Technical report. Cornwall, M.; Hammer, D.; LeLevier, R.; Vesecky, J. (Mitre Corp., McLean, VA (USA). Jason Program Office). May 1987. 30p. (JSR—85-405). NTIS, PC A03/MF A01.

This report focuses on the NRL laser facility, new experimental results from it, and computer models for the experiments. It makes a substantial contribution to the understanding of collisionless coupling, both with and without magnetic fields. It remains very important to stay focused on the critical question of early-time debris-air coupling related to late-time spatial structures. Cataloging collisionless phenomena is recommended for consideration while continuing to perform collisional experiments. Early-time shadowgraphy with radiating ambient gases should be considered. While aneurysms remain interesting phenomena, they may not be related to the primary HANEs explorations. Consideration is recommended of blunt-ended probes as a supplement to spherical obstacles in plasma-flow experiments. The use of a fast multichannel device is recommended after the spectrometer and the consideration of two-color interferometry as diagnostic tools. The purposeful exploration of target variation is recommended through the deliberate use of spherical or hemispherical and other non-flat targets of planned inhomogeneity. Increased correspondence between experimental simulations and the HANE data base is recommended. Two-dimensional modeling efforts are anticipated and the consideration is suggested of special-purpose machines or parallel machines before investing in more conventional computers for such modeling.

43954 (AD-A—181152/0/XAB) Path effects in strong-motion seismology. Final report, 11 January 1983-10 January 1986. Helmberger, D.V.; Harkrider, D.G.; Clayton, R.W. (California Inst. of Tech., Pasadena (USA). Seismological Lab.). Jan 1986. 94p. (SCIENTIFIC—3). NTIS, PC A05/MF A01.

Records of earthquake- and explosion-induced motions are studied by seismologists: 1) to learn the details of earthquake and explosion sources; 2) to determine earth structure; and 3) from the knowledge of sources and structures, to predict the shaking at the surface of the earth from earthquakes and explosions. This paper explores methods of computing the motions that result from elastic waves propagating through complex structures. These methods are applied to understand the effect of laterally varying near-surface geologic structure on ground motions. Strong-ground-motion waveforms recorded by seismic stations on soft-rock sites are generally more complicated than those recorded on hard-rock sites. Unfortunately, from a modeling point of view, most earthquakes occur in complicated geologic settings. Since cities, and therefore strong-motion instruments, tend to be in basins, interpretations of the strongest motion records require consideration of propagation through complex structures. Some progress has been made in modeling longer-period waveforms, particularly from nuclear blasts. Fewer parameters suffice to describe explosions than earthquakes and they are generally better known. Some aspects of explosion modeling are reviewed. A source description is developed for use in 2-dimensional finite-difference or finite-element methods that can produce approximate point-source seismograms that include the effects of complex structures.

43955 (AD-A—995485/0/XAB) Flashblindness and chorioretinal burn research. 1952-1962. Technical progress report. Corkhill, D.P.J. (Defense Atomic Support Agency, Washington, DC (USA)). 1 Sep 1985. 152p. (DASA—544(EX)). NTIS, PC A08/MF A01.

Extracted version of report dated 22 May 1964.

43956 (AD-A—995487/6/XAB) Operation Redwing, CJTF - Seven Administrative Order 1-56. (Joint Task Force Seven, Washington, DC (USA)). 30 Mar 1987. 62p. (CJTF—7-AO-1-56(EX)). NTIS, PC A04/MF A01.

Extracted version of report dated 20 Jan 1956.

43957 (AD-B—017277/5/XAB) Aircraft shelter conceptual study. Final report. (Civil Nuclear Systems Corp., Albuquerque, NM (USA)). Jan 1977. 319p. NTIS, PC A14/MF A01.

Distribution limitation now removed.

Concepts for shelters to protect aircraft from severe nuclear and nonnuclear weapon threats are developed and evaluated. Three of the more promising of the preliminary concepts considered are developed to the point where cost and merit can be evaluated and compared to select the optimum shelter system. The optimum system, the Covered Corridor Concept, is developed to the preliminary design stage. The concept is defined in detail; design requirements and criteria are presented; calculations and analyses of pri-

mary structural elements subjected to the design loads are documented; and preliminary design drawings are prepared. Ground shock and shelter motions due to the specified threat are estimated and the potential effect of such motions on sheltered aircraft are disucssed. Primary areas of uncertainity which should receive further study prior to proceeding with more detailed design are indentified.

43958 **(AD-B—019981/0/XAB) General test plan, pulsed-voltage failure levels of capacitors. Final report.** Tasca, D.M. (General Electric Co., Philadelphia, PA (USA). Space Div.). Apr 1977. 59p. NTIS, PC A04/MF A01.

Distribution limitation now removed.

The test plan of this program is to determine (1) pulsed voltage/power failure levels and (2) failure mechanisms for selected capacitors typical of those used in military electronic systems. The pulsed voltage/power levels of concern are those levels, with some safety margin, that could be induced in electronic components by electromagnetic pulse from nuclear weapons. Sufficient failure data are to be obtained so that device failure predictions are typical for each device; although statistical data collection is not required.

4503 Explosion Detection

43959 **(AD-A—181161/1/XAB) Location estimation using regional array data. Semi-annual report No. 1, February-August 1986.** Bratt, S.R.; Bache, T.C. (Science Applications International Corp., San Diego, CA (USA)). 31 Dec 1986. 66p. (SAIC—87/1564). NTIS, PC A04/MF A01.

A location estimation procedure for locating regional seismic events with a network including arrays and single element seismometers is described. The method incorporates back azimuth estimates, arrival time data and associated uncertainties into a generalized-inverse location estimate. The formulation allows the use of both a priori and a posteriori information about data uncertainties to compute confidence ellipsoids for the location estimates. This is important for obtaining realistic confidence ellipsoids for solutions based on few data. It provides for a refinement of the confidence ellipsoid calculations as experience accumulates for events in a particular area, and this is an important element of the regional location estimation procedure. Small arrays like NORESS in Norway provide accurate estimates for the back azimuth of regional phases. These azimuth data provide a strong constraint on the location for events detected by a small number of stations, including at least one array. The strength of the constraint depends on the geometry, and in some situations azimuth data are as important as arrival time data. Synthetic examples illustrating this are given for a network including two arrays. Comparing one array and two array locations and their confidence ellipses with these independent locations provides a preliminary validation of our estimates of the (signal-dependent) a priori arrival-time and azimuth variances and demonstrates the effectiveness of our location procedure for a sparse network of regional arrays.

50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC

5001 Basic Studies

43960 **(DOE/ER/60397—T1) Detection of CO_2-induced climate change: Progress report, 16 July 1986-15 July 1987.** Wigley, T.M.L.; Jones, P.D. (East Anglia Univ. (UK). Climatic Research Unit). Jul 1987. Contract FG02-86ER60397. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013127.

Progress in the following areas is reported: (1) southern hemisphere temperature data; (2) updating of gridded land-based surface air temperature data sets for both hemispheres; (3) use of satellite data in estimating monthly mean surface air temperatures; (4) comparison of UKMO and COADS marine temperature data sets; (5) amalgamation of land and marine (UKMO) temperature data sets; (6) analysis of gridded mean sea level pressure data; (7) regional validation of general circulation models; and (8) detection studies. (ACR)

43961 **(DOE/ET/20181—T1) Solar energy meteorological research and training site, Alaska.** Wendler, G. (Alaska Univ., Fairbanks (USA). Geophysical Inst.). 28 Jul 1987. Contract FG06-77ET20181. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013706.

The report briefly describes research results in the following areas: (1) radiation over snow; (2) Alaskan solar radiation data analysis; (3) turbidity measurements in the Alaskan region; (4) El Chichon volcanic cloud; (5) multiple reflection effects; and (6) cirrus cloud effects on solar radiation. (ACR)

43962 **(INIS-BR—712, pp 151-165) PIXE method as a microanalytical instrument.** Tabacniks, M.H. (Sao Paulo Univ., Brazil. Inst. de Fisica). 1985. (In Portuguese). NTIS (US Sales Only), PC A12/MF A01. File Number DE87703464. (CONF-8508241—).

From 8. workshop on nuclear physics; Sao Lourenco, MG, Brazil (31 Aug 1985).

The PIXE method as a microanalytical instrument to measure the air pollution in S.Paulo region, Brazil, is presented. A comparison with other analytical methods is shown. (L.C.).

43963 **(PNL—6242) Description of the Mountain Cloud Chemistry Program version of the PLUVIUS MOD 5.0 reactive storm simulation model.** Luecken, D.J.; Whiteman, C.D.; Chapman, E.G.; Andrews, G.L.; Bader, D.C. (Pacific Northwest Lab., Richland, WA (USA)). Jul 1987. Contract AC06-76RL01830. 97p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87012846.

Damage to forest ecosystems on mountains in the eastern United States has prompted a study conducted for the US Environmental Protection Agency's Mountain Cloud Chemistry Program (MCCP). This study has led to the development of a numerical model called MCCP PLUVIUS, which has been used to investigate the chemical transformations and cloud droplet deposition in shallow, nonprecipitating orographic clouds. The MCCP PLUVIUS model was developed as a specialized version of the existing PLUVIUS MOD 5.0 reactive storm model. It is capable of simulating aerosol scavenging, nonreactive gas scavenging, aqueous phase SO_2 reactions, and cloud water deposition. A description of the new model is provided along with information on model inputs and outputs, as well as suggestions for its further development. The MCCP PLUVIUS incorporates a new method to determine the depth of the layer of air which flows over a mountaintop to produce an orographic cloud event. It provides a new method for calculating hydrogen ion concentrations, and provides updated expressions and values for solubility, dissociation and reaction rate constants.

43964 **(PNL—6279-Vol.1) Hanford Meteorological Station computer codes: Volume 1, The GEN computer code.** Buck, J.W.; Andrews, G.L. (Pacific Northwest Lab., Richland, WA (USA)). Jul 1987. Contract AC06-76RL01830. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012816.

The Hanford Meteorological Station, operated by Pacific Northwest Laboratory, issues general weather forecasts twice a day. The GEN computer code is used to archive the 24-hour forecasts and apply quality assurance checks to the forecast data. This code accesses an input file, which contains the date and hour of the previous forecast, and an output file, which contains 24-hour forecasts for the current month. As part of the program, a data entry form consisting of 14 fields that describe various weather conditions must be filled in. The information on the form is appended to the current 24-hour monthly forecast file, which provides an archive for the 24-hour general weather forecasts. This report consists of several volumes documenting the various computer codes used at the Hanford Meteorological Station. This volume describes the implementation and operation of the GEN computer code at the station.

43965 **(RFP—4144) Validation of TRAC [terrain-responsive atmospheric code] transport and diffusion module.** (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1987. Contract AC04-76DP03533. 4p. (CONF-8706156—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012084.

From Workshop on evaluation of the TRAC dispersion model; Golden, CO, USA (24 Jun 1987).

The primary objective of the transport and diffusion module of TRAC is to determine the concentration of a pollutant at selected receptors for sources at any height under different meteorological conditions. This requires that the plume trajectory and plume dimensions be defined. Our presently planned validation experiments focus on these measurements.

43966 **(SAND—85-2180) Canyon-channeled wind, Sol se Mete Canyon.** Church, H.W. (Sandia National Labs., Albuquerque, NM (USA)). Jul 1987. Contract AC04-76DP00789. 41p. (TTC—0702). NTIS, PC A03. File Number DE87013841.

Nearly continuous wind and temperature measurements were made from an overhead cable-suspended array at four levels in a small canyon near Albuquerque, New Mexico. Direction and speed were sampled every 4 seconds, and component means, squares and cross products were recorded every 15 minutes. One year of data, in which data recovery averaged 85%, is summarized in this report to show usefulness of the site for small-scale atmospheric tracer release experiments.

43967 **(UCRL—96092) Tributary contribution to and interactions with air flow in a deep valley.** Porch, W.M.; Gudiksen, P.H.; Fritz, R.B.; Coulter, R. (Lawrence Livermore National Lab., CA (USA); National Oceanic and Atmospheric Administration, Boulder, CO (USA). Wave Propagation Lab.; Argonne National Lab., IL (USA)). May 1987. Contract W-7405-ENG-48. 7p. (CONF-870864—8). NTIS, PC A02/MF A01; GPO Dep. File Number DE87010870.

From 4. American Meteorological Society's conference on mountain meteorology; Seattle, WA, USA (25 Aug 1987).

This paper presents data which supports the hypothesis that nocturnal air subsidence is not only concentrated on the valley sides but mainly over the tributary walls. Smoke releases and tethersoude measurements revealed a three-layer structure to the flow exiting the tributary during nocturnal drainage conditions. First, there is a layer about 40 m deep just above the ground with a flow component out of the tributary with speeds of 1-3 m/s. The next higher layer is usually between 40 to 60 m with occasional excursions above 100 m and represents a region of either very low flow speeds (< 0.3 m/s) or actual backing flow into the tributary. The height of this counter flow layer appears to correspond with the projected height of the region of maximum flow speeds down the Brush Creek Valley. The third layer lies above the other two and extends to heights of 200 to 300 m. This layer contains relatively light flow (0.3 to 1.5 m/s) out of the tributary, but because of the height of the layer and much greater associated tributary valley cross sectional area, most of the tributary flow comes from this layer.

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REFER ALSO TO CITATION(S) 42969, 42974, 42975, 42976, 42998, 43209, 43231, 43406, 43463, 43480, 43484, 43487, 43488, 43489, 43490, 43491, 43492, 43503, 43662, 43799, 43809, 43951, 43960, 43963, 44026, 44044, 44205, 44206, 44207

43968 (CONF-8610316—, pp 6.1-6.26) **Information system for air pollution control in Czechoslovakia and its application in Prague.** Kurfuerst, J. 1986. (In German). NTIS (US Sales Only), PC A99. File Number DE87752961.

From CSR symposium and exhibition concerning the planning and protection of the human environment; Duesseldorf, F.R. Germany (1 Oct 1986).

Objective and varied information on the development and present-day status of atmospheric pollution are the basis for the planning, implementation, control and effectiveness assessment of both short-term and conceptual measure of air pollution control. The information system on air pollution control in Czechoslovakia contains data on emissions, emission inputs and complementary facts. The register for the emissions and emission sources stores and processes information on emissions and associated parameters classified according to four source categories: major: industrially ones; mean: municipal ones; minor: local and mobile ones. In 1985, the data from 686 measurement stations in Czechoslovakia were stored in this emission input information system.

43969 (CONF-8610316—, pp 8.1-8.23) **Centralized energy supply as a method for air pollution abatement in cities.** Brix, B. 1986. (In German). NTIS (US Sales Only), PC A99. File Number DE87752961.

From CSR symposium and exhibition concerning the planning and protection of the human environment; Duesseldorf, F.R. Germany (1 Oct 1986).

The generation of heat and power are the major factors in the air pollution of cities. Assessments of balances of fuel/emssion inputs and heat supply are used to forecast air pollution abatement.

43970 (CONF-8610316—, pp 9.1-9.31) **Pollutant monitoring and separation systems developed and manufactured in Czechoslovakia.** Tuma, J.; Koci, J. 1986. (In German). NTIS (US Sales Only), PC A99. File Number DE87752961.

From CSR symposium and exhibition concerning the planning and protection of the human environment; Duesseldorf, F.R. Germany (1 Oct 1986).

The paper reports the pollutant separation technology achieved in Czechoslovakia and major systems developed for treating solid, liquid and gaseous emissions. The function and the performance of several systems are demonstrated.

43971 (CONF-8610316—, pp 22.1-22.8) **Smog-alarm system in Northrhine-Westphalia.** Puetz, M. 1986. (In German). NTIS (US Sales Only), PC A99. File Number DE87752961.

From CSR symposium and exhibition concerning the planning and protection of the human environment; Duesseldorf, F.R. Germany (1 Oct 1986).

The papers gives a brief overview on smog hazards and their abatement as required by the regulation on smog whose contents are described. This is followed by a description of the smog alert service in Northrhine-Westphalia comprising 'Detection and reporting of smog situations' and 'Alarming the population'. The paper concludes with a report on the experience gained with the smog alert system.

43972 (CONF-8610316—, pp 23.1-23.13) **Research into air pollution and forest damage: Its concept exemplified by regional studies performed on the Eggegebirge mountain range.** Schmitt, O.A. 1986. (In German). NTIS (US Sales Only), PC A99. File Number DE87752961.

From CSR symposium and exhibition concerning the planning and protection of the human environment; Duesseldorf, F.R. Germany (1 Oct 1986).

Effective and targeted abatement of forest damage requires exact knowledge of the cause-effect relationships in novel forest injury types. The numerous damage-cause hypotheses which partially contradict each other, caused the government of Northrhine-Westphalia in 1984 to focus research by launching a project 'Air pollutants and forest injuries'. The application of a new research concept is reported.

43973 **(DOE/BP/13655—1) Two studies on the effects of small exhaust fans on indoor air quality: Field study of exhaust fans for mitigating indoor air quality problems; Indoor air quality, exhaust fan mitigation.** (Lawrence Berkeley Lab., CA (USA); Honeywell, Inc., Minneapolis, MN (USA). Technology Strategy Center). Jul 1987. Contract AC79-83BP13655. 220p. NTIS, PC A10. File Number DE87011895.

Overall, the findings show that exhaust fans basically provide small amounts of ventilation compensation. By monitoring the common indoor air pollutants (radon, formaldehyde, carbon monoxide, nitrogen dioxide, and water vapor), it was found that the

quality of the indoor air was not adversely affected by the use of exhaust fans. Nor did their use provide any measurable or significant benefits since no improvement in air quality was ascertained. While exhaust fans of this small size did not increase radon, which is the contaminant of most concern, the researchers caution that operation of a larger fan or installation in a very tight home could result in higher levels because depressurization is greater. The daily energy consumption for use of these appliances during the heating season was calculated to be 1.5 kilowatt hours or approximately 3% of the energy consumption in the study homes. The information collected in this collaborative field study indicates that the use of these particular ventilation systems has no significant effect on indoor air quality.

43974 **(DOE/ER/60397—T2) Testimony to the US Senate on the greenhouse effect.** Wigley, T.M.L. (East Anglia Univ. (UK)). [1987]. Contract FG02-86ER60397. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013995.

This testimony was presented on January 28, 1987 at the hearing on "The Greenhouse Effect, Climate Change and Ozone Depletion," United States Senate Committee on Environment and Public Works, Subcommittee on Environmental Protection and Subcommittee on Hazardous Wastes and Toxic Substances. The testimony concerns the observed global warming that has occurred over the past 100 years. How this temperature record was obtained is summarized and the details of the record described, with particular reference to the most recent decades and to the differences between the records for Northern and Southern Hemispheres. The record is compared with the predicted warming over the same period due to the effects of increasing greenhouse gas concentrations in the atmosphere. The projected warming over the next 70 years is compared with global temperature changes that have occurred over the past few million years. (ACR)

43975 **(DOE/LC/11049—2352) Design and testing of a mini Class A evaporation pan.** Vassar, A.; Pochop, L.; Hasfurther, V. (Wyoming Univ., Laramie (USA)). Mar 1987. Contract AC21-84LC11049. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87006487.

This report presents the results of a design and testing effort to develop an evaporation pan which is smaller than the Class A evaporation pan but which will produce an evaporation rate similar to that from a Class A pan. An energy balance simulation was used to design a mini Class A pan at a scale that would create an energy exchange, and thus an evaporation rate, equivalent to that occurring with a Class A pan. The mini pan was sized to have a water depth equal to and a water surface area less than that of a Class A pan. In order to achieve equivalent heat exchanges, the sides of the mini pan were insulated. Results of field tests comparing the evaporation rates from Class A pans and the mini pans are given. Measurements of daily evaporation rates were taken for nearly two months, and results indicate that the evaporation rates from the mini pans were comparable to those from a Class A pan.

43976 **(DOE/PC/80539—T8) Heterogeneous removal of sulfur dioxide by hydroxide aerosol: Technical progress report No. 7, April 1, 1987-June 30, 1987.** Stelson, A.W. (Atlanta Univ. Center, Inc., GA (USA). Dolphus E. Milligan Science Research Inst.). 30 Jul 1987. Contract FG22-85PC80539. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012670.

Experimental results are summarized with impacts on theory addressed. First by varying the oxygen concentration from 5 to 21% in the synthetic flue gas, oxygen was determined to be in great excess at 5% and the variance of oxygen over this range has no impact on the sulfur dioxide removals observed. Second, the presence of carbon dioxide has no impact on the sulfur dioxide removals observed. Third, the reaction of sulfur dioxide with sodium hydroxide or potassium hydroxide is quite rapid and occurs at reasonably low temperatures. Fourth, the experimental apparatus cannot differentiate between the rate of the sodium hydroxide reaction and the rate of the potassium hydroxide reaction. Fifth, the resulting aerosol is acidic indicating acidic sulfuric acid salts of potassium and sodium are formed. Sixth, the aerosol particles formed by atomization and subsequent drying are of density much less than the crystalline density of sodium hydroxide and potassium hydroxide and these particles ($\sim$20 μm) offer minimal diffusional resistance to the reaction with sulfur dioxide.

43977 **(ECN—87-068) A simple model of below-cloud scavenging processes.** Janssen, A.J.; Slanina, J.; Voors, P.J. (Netherlands Energy Research Foundation, Petten). May 1987. 45p. ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

A model has been developed which describes the most important below-cloud scavenging processes in raindrops. Calculations have been made for areas in the Netherlands outside the direct influence of point sources. Even in these areas below-cloud scavenging of SO/sub 2/ can be quite important (about 25% contribution to the wet SO/sub 4//sup 2-/ deposition if the cloud base is at 800 m), which is due to the high NH/sub 3/ concentrations in the Netherlands. Below-cloud scavenging coefficients of NH/sub 3/ and HNO/sub 3/ are about 40% per hour and 30% per hour, respectively; the below-cloud scavenging coefficient of SO/sub 2/ can easily vary between 5% and 20% per hour, depending on many local circumstances. 2 figs., 9 tabs., 22 refs.

43978 **(EML—456) TAPS: Tethered air pump system.** Latner, N. (USDOE Environmental Measurements Lab., New York). Jul 1986. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013831.

A rugged, 275 gram air sampler/control unit, which maintains constant air flow, has been developed for tethered balloon applications. Housed in a resilient foam case, and powered by a compact lithium battery, it is easily attached to the tether line and accurately draws known amounts of air through its sampling tube.

43979 **(EPRI-EA—5335) Estimating the impact of ozone on crops: Final report.** Kinsman, J.; Saunders, P.; Carriere, W. (International Science and Technology, Inc., Reston, VA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jul 1987. 182p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920542.

Alternative dose-response equations for assessing the effects of ozone (O_3) on soybeans were established, using experimental data from the National Crop Loss Assessment Network (NCLAN) study. For each of three soybean varieties, eight different models (e.g., linear, second degree polynomial, the Weibull function) were fitted for six measures of O_3 dose during the flowering to maturity period of soybean growth. The six dose measures were 7-hour (0900-1600) and 12-hour (0700-1900) means, 7-hour and 12-hour total doses (in units of ppM-hr), and the 90th and 75th percentile O_3 concentrations (i.e., the O_3 concentration which is exceeded during only 10 and 25% of all hours). Ozone data from remote sites were analyzed to determine typical natural (background) O_3 concentrations, which serve as a baseline against which to calculate yield reductions. Using O_3 monitoring data for rural sites only, hourly O_3 levels were established for the states of Illinois, Indiana, Kentucky, and Virginia. From these hourly O_3 concentrations, county-level doses were calculated and soybean losses due to O_3 were determined.

43980 **(LBL—22153) Applied Science Division Indoor Environment Program: Annual report, FY 1986.** Cairns, E.J.; Grimsrud, D.T. (Lawrence Berkeley Lab., CA (USA)). May 1987. Contract AC03-76SF00098. 48p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013959.

Separate abstracts have been prepared for papers describing individual research programs. (ACR)

43981 **(LBL—22154) Applied Science Division Environmental Research Program: Annual report, FY 1986.** Cairns, E.J.; Novakov, T. (Lawrence Berkeley Lab., CA (USA)). May 1987. Contract AC03-76SF00098. 37p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013958.

The objective of the Environmental Research Program is to understand the formation, transformation, transport, and effects of energy-related pollutants on the environment. This multidisciplinary research program includes fundamental and applied research in physics, chemistry, engineering, and biology, as well as research on the development of advanced methods of measurement and analy-

sis. This annual report contains summaries of research performed during FY 1986 in the areas of atmospheric aerosols, flue gas chemistry, combustion, membrane bioenergetics, and analytical chemistry.

43982 **(PB—87-191524/XAB) Lung cancer and indoor exposure of unvented coal and wood combustion emissions in Xuan Wei, china.** Mumford, J.L.; Chapman, R.S.; Harris, D.B.; He, X.Z.; Cao, S.R. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). May 1987. 12p. (EPA—600/D-87/145). NTIS, PC A02/MF A01.

Residents of Xuan Wei County in China have unusually high lung cancer mortality that cannot be attributed to tobacco use or occupational exposure. They are exposed to smoke from unvented, open pit coal or wood fires (often used for cooking and heating). The variation in lung cancer rates among communes within the county suggests that indoor combustion of smoky coal may be the prime determinant of lung cancer. To characterize the air in Xuan Wei homes, samples of the air particles and semivolatile organics were collected from homes located in communes with different lung-cancer rates. Samples collected in the commune in which the lung-cancer rate is high and smoky coal is the predominant fuel-contained high concentrations of submicron particles with high organic content; organic extracts of these samples were mutagenic. Samples from homes in a wood-burning commune, which has a low lung-cancer rate, consisted mostly of larger particles of lower organic content and mutagenicity. The smoky coal sample was also a more potent skin-tumor initiator compared to the wood or smokeless coal sample and was a mouse skin carcinogen.

43983 **(PB—87-191607/XAB) Volatile organic chemicals in 10 public-access buildings.** Wallace, L.; Jungers, R.; Sheldon, L.; Pellizzari, E. (Research Triangle Inst., Research Triangle Park, NC (USA)). May 1987. 9p. NTIS, PC A02/MF A01.

The U.S. EPA carried out studies of indoor air quality in 10 buildings. Qualitative analysis identified over 200 aromatics, halogens, esters, alcohols, phenols, ethers, ketones, aldehydes, and epoxides, in addition to several hundred aliphatic hydrocarbons. The total organic load for nine buildings exceeded outdoor levels, by factors of up to 100 for new buildings. New buildings had high levels of eight organics (e.g., decane, xylenes, 1,1,1-trichloroethane). Levels in three new buildings declined with half-lives of 2-8 weeks. For some chemicals (e.g., trichloroethylene) levels increased with time, indicating the influence of consumer products or activities.

43984 **(PB—87-191805/XAB) Gases from explosives detonated in underground mines. Open File Report, October 1984-June 1986.** Garcia, M.M.; Malcomson, M. (Arizona Univ., Tucson (USA). Dept. of Mining and Geological Engineering). Jun 1986. 98p. NTIS, PC A05/MF A01.

See also PB—83-191718.

The report describes the measurement and identification of the gases produced by explosives detonated under actual mining operations in an underground mine. A brief background about the nature of the problem and the objectives of the investigation are presented, as well as a brief summary of previous studies regarding gases produced in trace quantities and entrapped in the muck pile and surrounding mine rock. Also included are discussions of selected explosives, detailed descriptions of the test chamber, the mining procedures used to generate the gases, a description of the analytical instruments and procedures used to monitor and identify the gases, and a presentation of the experimental results, conclusions, and recommendations.

43985 **(PB—87-193009/XAB) Poison gas accident in Bhopal, India, December 2-3, 1984).** Kulling, P.; Lorin, H. (Katastrofmedicinska Organisationskommitten, Stockholm (Sweden)). 1987. 79p. (In Swedish). (KAMEDO—53). NTIS, PC PC E04/MF E01.

In the Union Carbide's plant in Bhopal, methylisocyanate was an intermediate in the production of the carbamate insecticide carbaryl, or Sevin as the Union Carbide Corporation trade name, MIC is a low molecular organic isocyanate (MW 57.05). It is volatile as the boiling point is low (+39°C) and colorless with an unpleasant odor. The vapor density is 2, i.e. twice as heavy as air, and it reacts violently with for example water in an exothermic reaction. It is a strong irritant. The cause of the gas leak was that the safety valve on a tank opened as a result of a chemical reaction giving a pressure increase in the tank that contained approximately 35 tonnes of stored MIC. The safety valve remained open for nearly two hours. An excess of 50,000 pound of MIC in vapor and liquid form was discharged.

43986 **(PB—87-193629/XAB) Resampling and extreme-value statistics in air-quality-model performance evaluation.** Rao, S.T.; Sistla, G.; Pagnotti, V.; Petersen, W.B.; Irwin, J.S. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). 1985. 18p. NTIS, PC A02/MF A01.

Pub. in Atmospheric Environment, Vol. 19, No. 9, 1503-1518(1985).

Specific data-analysis techniques that will reveal the performance of air-quality models in simulating the measured concentrations' cumulative distribution are discussed. The paper presents two types of analysis to compare model predictions with the measurements. In one analysis, extreme-value statistics and the fitting of tail exponential distributions to both measured and predicted values are used in various ways to see if the measured and predicted values fit such distributions and to what degree the higher values of the cumulative frequency distributions coincide. In the second analysis, a resampling (bootstrap technique is used to develop non-parametric confidence intervals for the entire cumulative distribution of the measured concentrations, and to derive empirical distributions for central tendency statistics and for differences between measured and predicted mean and median values. The analysis is focused so as to show (1) why the resampling is necessary and the degree to which mistaken judgments can be made with and without the technique, and (2) comparisons between the discriminating capabilities of 'tail fit' type model evaluation and one using the resampling technique. It is shown that both the bootstrap and extreme value statistics are needed to quantify the uncertainty associated with the model predictions.

43987 **(PB—87-194411/XAB) Cadmium emissions from cadmium refining and primary zinc/zinc oxide smelting--phase 1 technical report.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). May 1987. 37p. (EPA—450/3-87/011). NTIS, PC A03/MF A01.

This is a technical report on cadmium emissions from cadmium refining and primary zinc/zinc oxide smelting. Descriptions of these industries and associated air pollution control equipment are presented. Cadmium emissions from all plants in the U.S. in these two source categories are presented. Health risks from exposure to cadmium air emissions from each plant is also discussed.

43988 **(PB—87-194684/XAB) Evaluation of the feasibility of liquid fillneck seals. Technical report.** (Environmental Protection Agency, Ann Arbor, MI (USA)). Dec 1986. 58p. (EPA/AA/SDSB—86/3). NTIS, PC A04/MF A01.

The report evaluates the feasibility of using liquid fillneck seals instead of mechanical fillneck seals. The issue is a concern because the only significant uncontrolled source of hydrocarbon emissions from motor vehicles is the gasoline vapor which escapes during motor vehicle refueling. In an uncontrolled refueling, the vapors that are displaced during the refueling, the vapors that are displaced during the refueling event pass through the fillneck and escape to the atmosphere. Systems designed to control these emissions are called refueling vapor control systems. When the controls are vehicle based, they are generally referred to as onboard vapor recovery system.

43989 **(PB—87-194742/XAB) Cooperative research in atmospheric science under the US-PRC (United States-People's Republic of China) environmental protection protocol.** Wilson, W.E. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). 1987. 7p. (EPA—600/M-87/017). NTIS, PC A02/MF A01.

Pub. in China Exchange News, National Academy of Sciences, Vol. 15, No. 2, 18-21(Jun 1987).

The Atmospheric Sciences Research Laboratory's (ASRL) efforts in arranging cooperative research projects under the US-PRC Environmental Protection Protocol are described. Completed and ongoing projects are reported and projects now being negotiated are noted.

43990 **(PB—87-195350/XAB) Application of a three-dimensional photochemical smog formation model to the Tokyo metropolitan area.** Wakamatsu, S.; Uno, I.; Schere, K.L. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). May 1987. 15p. (EPA—600/D-87/175). NTIS, PC A02/MF A01.

Relatively high O_3 concentrations were observed during an episode on July 16 and 17, 1981 in the Tokyo Metropolitan Area. The stagnant meteorological conditions which existed then were mainly caused by the local sea and land wind-circulation systems. To better understand the physical and chemical relationships at work during this particular episode, the SAI Urban Airshed Model (UAM) was applied. Vertical cross sections of simulated pollutant patterns are analyzed for the Tokyo domain, including the diurnal variation in the patterns. The effects of vertical meteorological conditions and the previous day's secondary pollutants are emphasized. The entrainment of O_3 and CARB from aloft on the second day of simulation was shown to have significant impact on the timing and location of the second day's maximum O_3. Limited field-observed data from aircraft for O_3 are compared with the simulated results.

43991 **(PB—87-195376/XAB) Air-quality data-analysis system for interrelating effects, standards, and needed source reductions. Part 9. Calculating effective ambient air-quality parameters.** Larsen, R.I.; Heck, W.W. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). 1985. 8p. (EPA—600/J-85/484). NTIS, PC A02/MF A01.

Pub. in APCA Jnl., Vol. 35, No. 12, 1274-1279(Dec 1985).

Ambient air-quality data can often be characterized by the two characteristic parameters of the lognormal distribution, the geometric mean, and the standard geometric deviation, but some ambient data are far from lognormal. The paper suggests that even though an air quality data set is not lognormal, the effects of the concentrations can be characterized with an effective geometric mean and an effective standard geometric deviation calculated from the effective and arithmetic means. These two effective parameters can be used to characterize air-quality at a site, in terms of its expected effects on plants, and to compare these parameters and the expected plant effects from site to site.

43992 **(PB—87-195384/XAB) New York City bus-terminal diesel emissions study: measurement and collection of diesel exhaust for chemical characterization and mutagenic activity.** Burton, R.M.; Suggs, J.C.; Jungers, R.H.; Lewtas, J. (Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Monitoring and Systems Lab.). May 1987. 17p. (EPA—600/D-87/180). NTIS, PC A02/MF A01.

The paper is concerned with the impact of diesel emissions on the quality of the ambient air and the resulting effects on human health. The study was designed to chemically characterize and bioassay heavy-duty diesel engine exhaust as it exists in the ambient atmosphere. Diesel-emission aerosols were collected inside and outside a large New York City bus terminal in which 1400 buses operated daily. Organics were extracted from inside and outside particulate matter and were fractionated into chemical classes. Air particle concentration inside the building was nearly 3 times greater than outside with the increase in the <1.7 micron particle size. Although both the small particle and extractable organic concentrations were lower outside the terminal, the mutagenicity of the organics (revertants/microgram organics) from outside was nearly 10 times greater than inside the terminal. Results are consistent with studies showing that aged atmospheric organics, having undergone atmospheric transformations, have an increased mutagenic response over fresh aerosol emitted directly from combustion sources.

43993 **(PB—87-195400/XAB) Demonstration of INPUFF with the MATS data base.** Petersen, W.B. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). 1986. 9p. (EPA—600/J-86/357). NTIS, PC A02/MF A01.

Pub. in Atmospheric Environment, Vol. 20, No. 7, 1341-1346(1986).

An integrated puff model, INPUFF, is evaluated using the MATS data base. A description of the model is provided outlining the salient characteristics. A brief description of the MATS data base, which consists of 14 SF_6 tracer releases with associated meteorology, is also provided. INPUFF slightly overestimated peak concentrations. Since the SF_6 puffs were well mixed for every tracer release, model performance is very sensitive to estimates of the mixing heights. The absolute mean fractional error between two techniques for estimating the mixing height was 0.87, which indicates a large uncertainty in the very important input parameter.

43994 **(PB—87-195426/XAB) Non-methane organic composition in the Lincoln Tunnel.** Lonneman, W.A.; Seila, R.L.; Meeks, S.A. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). 1986. 9p. (EPA—600/J-86/356). NTIS, PC A02/MF A01.

Pub. in Environmental Science Technology, Vol. 20, No. 8, 790-796(Aug 1986).

Recent 1982 measurements of the nonmethane organic compound (NMOC) are reported for the Lincoln Tunnel. The NMOC levels in the tunnel were a factor of approximately 4 lower than 1970 levels. The decrease probably reflects reduced vehicular tailpipe emissions due to EPA hydrocarbon control strategy for photochemical ozone. Acetylene contribution to the total NMOC composition decreased almost by a factor of 2 from 1970 to 1982. The decrease was attributed to the preferential oxidation of acetylene by the vehicular catalytic device. New hydrocarbon component and sum of NMOC component ratios to acetylene are presented. These ratios are useful in the determination of hydrocarbon-source-emission contribution in urban and industrial areas.

43995 **(PB—87-196085/XAB) Injury and yield response of cotton to chronic doses of ozone and sulfur dioxide.** Heagle, A.S.; Heck, W.W.; Lesser, V.M.; Rawlings, J.O.; Mowry, F.L. (North Carolina State Univ., Raleigh (USA)). 1986. 11p. NTIS, PC A02/MF A01.

Pub. in Jnl. of Environmental Quality, Vol. 15, No. 4, 375-382(Oct-Dec 1986).

Knowledge of relationships between chronic doses of O_3 and crop yield is required to set air-quality standards that protect agricultural interests and to determine the need to develop resistant cultivars of sensitive species. Open-top field chamber studies have provided some information of this type for a few crop species including one western cultivar of cotton. The authors objectives were to measure relationships between chronic doses of O_3 and yield of an eastern cotton cultivar and to determine whether these relationships could be affected by chronic doses of SO_2. Stoneville 213 was exposed in open-top field chambers to five doses O_3 and four doses of SO_2 singly, and in all possible combinations. Exposures began when first foliar leaves were expanding and continued until final harvest. Doses of SO_3 at levels greater than those occurring regionally did not significantly change cotton response to O_3.

43996 **(PB—87-196101/XAB) Quantifying uncertainty in long-range-transport models: a summary of the AMS (American Meteorological Society) workshop on sources and evaluation of uncertainty in long-range-transport models, Woods Hole, Massachusetts, 18-21 September 1984.** Demerjian, K.L. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). 1985. 10p. (EPA—600/J-85/488). NTIS, PC A02/MF A01.

Pub. in Bulletin of the American Meteorological Society, Vol. 66, No. 12, 1533-1540(Dec 1985).

The American Meteorological Society, under sponsorship from the U.S. Environmental Protection Agency, the Atmospheric Environment Service, Canada, and the Ontario Ministry of the Environment, Canada, convened a workshop in September 1984 to address one aspect of the long-range transport modeling which has become a topic of considerable concern, i.e., the quantification of uncertainty in long-range transport-model predictions.

43997 **(PB—87-196515/XAB) Characteristics of vertical turbulent velocities in the urban convective boundary layer.** Godowitch, J.M. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). 1986. 23p. (EPA—600/J-86/354). NTIS, PC A02/MF A01.

Pub. in Boundary-Layer Meteorology, Vol. 35, 387-407(1986).

Time series of vertical velocity fluctuations from horizontal aircraft-flight segments made in the lower part of and near the middle of the convective boundary layer (CBL) over St. Louis, Missouri, and surrounding region were subjected to various statistical and objective analyses. The higher-order vertical-velocity moments, and positive and negative velocity statistics, were computed. The horizontal dimensions of updrafts and downdrafts, and related properties of these turbulent eddies were derived by conditional sampling analysis. Statistical results show that the means and standard deviations of positive and negative velocity fluctuations were greater over the urban area. The urban vertical velocity variance was 50% greater than rural values, and power spectra revealed greater production of vertical turbulent energy in the urban area over a wide frequency range. Convective similarity scaling parameters appeared to order both the urban and rural measurements.

43998 **(PB—87-198545/XAB) Forest resources in Maryland and acid deposition. Final report.** Hood, B.A.; Bruck, R.I.; Bernabo, J.C. (Science and Policy Associates, Inc., Washington, DC (USA)). Oct 1986. 46p. NTIS, PC A03/MF A01.

More than 40% of Maryland's land area is commercial forest land. Oak-hickory is the dominant forest type, constituting 46% of commercial forest land and 49% of growing-stock volume. Hardwood species account for 77% of the growing-stock volume but loblolly pine is the greatest timber resource in Maryland. No effects of acid deposition on the forest resources in Maryland have yet been documented and none are anticipated at current levels of deposition. Other atmospheric pollutants namely ozone, may be causing effects on forest trees in Maryland. At present, natural or unexplained stresses (e.g., insects, drought, climate change) are causing most of the reported damages to forest trees in Maryland.

43999 **(PB—87-198685/XAB) Patterns of wet deposition of acidic matter in Maryland: January-June 1984. Final report.** Maxwell, C.; Bartoshesky, J.; Pfeffer, N.; Campbell, S. (Martin Marietta Environmental Systems, Columbia, MD (USA)). 3 Mar 1987. 299p. NTIS, PC A13/MF A01.

A data base containing precipitation-chemistry data collected by multiple monitoring programs in and around Maryland for the January through June 1984 time period was compiled. Isopleth maps were constructed showing the spatial variation in the precipitation concentrations and depositions of hydrogen ion, sulfate, nitrate, ammonium, calcium, sodium, chloride, potassium, and magnesium. For each parameter, the concentration pattern was very similar to its deposition pattern. The patterns suggest the occurrence of a ridge of high sulfate, nitrate, and hydrogen ion concentrations and depositions extending from south-central Pennsylvania, south into Maryland along the western shore of the Chesapeake Bay.

44000 **(PB—87-198768/XAB) Investigation of the feasibility of using the MESOPUFF II model for predicting acid deposition in Maryland. Final report.** Kumar, S. (Martin Marietta Environmental Systems, Columbia, MD (USA)). 3 Mar 1987. 77p. NTIS, PC A05/MF A01.

The MESOPUFF II model was procured and installed on Martin Marietta Environmental Systems' VAX 11/780 computer to evaluate the feasibility of running the model for a whole year of input data and to estimate, on a test basis, the concentration and deposition of acid pollutant species due to Maryland sources at receptors in Maryland over a limited period (i.e., March 1984). The model package was successfully installed and exercised for the test period under various source scenarios. Further, it was determined that the critical resource demands associated with running the model for an entire year would be disk space to store the preprocessed meteorological data and computer CPU time to run the main module, MESOPUFF.

44001 **(PB—87-198776/XAB) Equilibration of polychlorinated biphenyls and toxaphene with air and water.** Murphy, T.J.; Mullin, M.D.; Meyer, J.A. (Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab.). 1987. 11p. (EPA—600/J-87/025). NTIS, PC A02/MF A01.

Pub. in Environmental Science and Technology, Vol. 21, No. 2, 155-162(Feb 1987).

The vapor pressure and solubility (as subcooled liquids) and Henry's Law constants (HLCs) for the individual chlorobiphenyl compounds (CBC) in Aroclor 1242, 1254, and 1260, as well as the HLCs for toxaphene, were determined with an equilibrium technique. The results were obtained from one set of measurements, for all of the CBC present in the materials of interest, the subcooled organic mixtures that are partitioning in the environment. The HLCs are such that the transport rate of these compounds through the air/water interface should be dependent on both the gas- and liquid-phase mass-transfer coefficients. The solubility of the polychlorinated biphenyls (PCBs) in water is shown to be significantly lower when a solution is prepared by adding an organic solution (acetone, methanol, etc.) of the PCBs to water. These results affect the design and the interpretation of the results from toxicity experiments.

44002 **(PB—87-198792/XAB) Mutagenicity of indoor air particles in a residential pilot field study: application and evaluation of new methodologies.** Lewtas, J.; Goto, S.; Williams, K.; Chuang, J.C.; Petersen, B.A. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). 1987. 10p. (EPA—600/J-87/029). NTIS, PC A02/MF A01.

Pub. in Atmospheric Environment, Vol. 21, No. 2, 443-449(1987).

The mutagenicity of indoor air-particulate matter was measured in a pilot field study of homes in Columbus, Ohio, during the 1984 winter. The study was conducted in eight all-natural-gas homes and two all-electric homes. Particulate matter and semi-volatile organic compounds were collected indoors using a medium-volume sampler. A micro-forward mutation bioassay employing Salmonella typhimurium strain TM 677 was used to quantify the mutagenicity in solvent extracts of microgram quantities of indoor air particles. The mutagenicity was quantified in terms of both mutation frequency per mg of organic matter extracted and per cubic meter of air sampled. The combustion-source variables explored in this study included woodburning in fireplaces and cigarette smoking. Homes in which cigarette smoking occurred had the highest concentrations of mutagenicity per cubic meter of air.

44003 **(PB—87-198974/XAB) Transport of acidic matter in Maryland: May-December 1984, Final report.** Bartoshesky, J.; Maxwell, C.; Pfeffer, N.; Roig, R. (Martin Marietta Environmental Systems, Columbia, MD (USA)). 3 Mar 1987. 296p. NTIS, PC A13/MF A01.

An analysis of air-mass trajectories associated with precipitation events was conducted using the Heffter transport model and precipitation event data from May-December 1984 at two collection sites in Maryland's coastal plain. Heffter trajectories were computed for events in which most or all chemical analyses were performed and in which information on event start and stop times was available.

44004 **(PB—87-199154/XAB) Organic emission measurements via small chamber testing.** Tichenor, B.A. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). Jun 1987. 12p. (EPA—600/D-87/187). NTIS, PC A02/MF A01.

The paper discusses the measurement of organic emissions from a variety of indoor materials, using small (166 liter) environmental test chambers. The following materials were tested: adhesives, caulks, pressed wood products, floor waxes, paints, solid insecticides. For each material, chamber concentration of organics has been determined for a range of environmental conditions (e.g., air exchange rate, temperature, and relative humidity). Various product loading ratios (area of sample/volume of chamber) have also been investigated. Emission rates for individual organic compounds, as well as total measured organics, were calculated. The effects of environmental variables on emission rates have been evaluated. Models are used to evaluate the effect of chamber walls and concentration on emission rates.

44005 **(PB—87-199642/XAB) Formation of transient puffs from contained liquid wastes in a rotary-kiln simulator.** Linak, W.P.; McSorley, J.A.; Wendt, J.O.L.; Dunn, J.E. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). Jun 1987. 38p. (EPA—600/D-87/196). NTIS, PC A03/MF A01.

This paper gives results of a study of the generation of transient puffs resulting from the batch incineration of liquid waste into a 73-kW rotary-kiln-incinerator simulator. Liquid wastes investigated included toluene, methylene chloride, carbon tetrachloride, and No. 5 fuel oil. Transient puffs from these wastes were monitored using on-line measurements for FID measurable hydrocarbons, carbon monoxide, and integrated particulate filter loadings, although the suitability of any one of these indicators depended on the chemical nature of the waste involved. Study results show that puffs formed during transient conditions are generated easily, even with small quantities of wastes and with the kiln operating at 100% excess air.

44006 **(PB—87-199659/XAB) Determination of PH rate constants for six volatile organics in air using the UCR (University of California-Riverside) protocol.** Arnts, R.R.; Seila, R.L.; Bufalini, J.J. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). Jun 1987. 19p. (EPA—600/D-87/197). NTIS, PC A02/MF A01.

An important mechanism of chemical transformation of organic pollutants in the atmosphere is through oxidation by OH radicals. A relatively simple laboratory procedure for determining the OH rate constants in air was developed. To determine the rate, a teflon bag is filled with 10-15 ppm of methyl nitrite, 5 ppm of nitric oxide, 2 ppm of test compound, and 2 ppm of an organic which has an accurately known OH rate constant. The mixture is irradiated with blacklamps and the concentrations of the reference and test organic are measured over a 45-minute period. Results are detailed in the report.

44007 **(PB—87-199667/XAB) Analyses of PEM-2 (Pollution Episodic Model Version 2) model-evaluation results for short-term urban particulate matter.** Godowitch, J.M. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). Jun 1987. 53p. (EPA—600/3-87/022). NTIS, PC A04/MF A01.

The Pollution Episodic Model Version 2 (PEM-2), an urban dispersion model, was evaluated with measurements from the 1982 Philadelphia Aerosol Field Study data base in order to investigate its ability to model 12-hour average concentrations of particulate matter less than 10 micrometers (PM_{10}). Regional PM_{10} background was derived from the measured concentration at an upwind site selected as the background monitor with the modeled PM_{10} concentrations subtracted because all sites were in the emissions region. About 70% of the measured PM_{10} at most monitoring sites was contributed by regional background. Model performance was determined from statistical measures of difference and correlation between observed and modeled concentrations paired in time and location. Statistical results were better for modeled plus background values versus observed concentrations. Mean and high-five PM_{10} concentrations from the PEM-2 model were about 25% lower than RAM predictions at four sites within the city limits, and 35-40% lower at the two most-distant sites from the urban center.

44008 **(PB—87-199675/XAB) Production of mutagenic compounds as a result of urban photochemistry. Interim report, July 1983-February 1987.** Shepson, P.B.; Kleindienst, T.E.; Edney, E.O. (Northrop Services, Inc., Research Triangle Park, NC (USA)). Jun 1987. 86p. NTIS, PC A05/MF A01.

A series of atmospheric simulation experiments was conducted to examine the role of urban photochemical processes on the formation and removal of potentially hazardous air pollutants. The chemicals examined included ubiquitous urban pollutants (e.g., propylene, toluene, and acetaldehyde), a potentially hazardous chlorinated solvent (allyl chloride), and complex mixtures (wood smoke and auto exhaust) from common urban pollutant sources. In all cases, the irradiated products were more mutagenic than the original chemicals.

44009 **(PB—87-201125/XAB) Massachusetts acid-rain-monitoring project. Phase 1. Completion report.** Godfrey, P.J.; Ruby, A.; Zajicek, O.T. (Massachusetts Univ., Amherst (USA). Water Resources Research Center). Jan 1985. 243p. (PUB—147). NTIS, PC A11/MF A01.

In an effort to assess the sensitivity of Massachusetts surface waters to acid deposition, approximately 40% of Massachusetts fresh-water surface waters were included in a statewide water-chemistry survey conducted from March 1983 to April 1984. Samples were collected monthly by volunteers and analyzed for pH and alkalinity at local volunteer laboratories. Quarterly analyses of samples for major anions and cations, aluminum, and color were done at the University of Massachusetts. The vast majority of waters studied were found to be sensitive to long-term acidification. Quarterly analysis of samples for major anions and cations, aluminum and color indicated that the likely source of high-surface-water acidity and sulfate concentrations is atmospheric deposition of strong mineral acids.

44010 **(PB—87-201513/XAB) Research overview: sources of indoor air pollutants.** Tucker, W.G. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). Jun 1987. 14p. (EPA—600/D-87/207). NTIS, PC A02/MF A01.

This paper briefly traces the history of air-quality problems in residential, office, and public-access buildings to show the evolution of indoor air quality (IAQ) concerns. It then briefly discusses sources of IAQ problems--both known and suspected--then reviews the current state of knowledge of emissions from these sources. It summarizes recent and current research in federal and private-sector organizations. Combustion sources, material source (e.g., building materials and consumer products), activity sources (e.g., cleaning, maintenance, and cooking), and outside sources (e.g., outdoor air, soil gas, and contaminated groundwater) are used as categories to describe the complex problems being researched. The paper concludes with suggestions to building design, construction, and management professionals regarding prudent steps that can be taken to reduce potential IAQ problems from sources of greatest potential concern in today's residential, office, and public access buildings.

44011 **(PB—87-204400/XAB) Evaluation test on a hospital refuse incinerator at Saint Agnes Medical Center, Fresno, California. Air pollution test report.** Jenkins, A.C.; Ouchida, P. (California State Air Resources Board, Sacramento (USA). Stationary Source Div.). Jan 1987. 110p. (ARB/SS—87-01). NTIS, PC A06/MF A01.

An evaluation test program was conducted to evaluate the emissions from a hospital-refuse incinerator. The test was conducted as a part of the Air Resources Board's program to assess emissions from stationary sources. The incinerator was operated at an average burn rate of 780 pounds of hospital refuse per hour during the entire test period. Daily average oxygen and carbon dioxide concentrations ranged from 13.3% and 5.8%, respectively to 16.3%

and 3.8%. The carbon monoxide concentrations were less than 50 parts per million by volume, (PPMV), during the entire test period. Analysis for selected trace metals was conducted and emission rates determined. Mass emission rates for chlorinated and aromatic compounds were determined. Sampling for PCDDs and PCDFs was conducted to assess if hospital incinerators had the potential to emit such compounds. Based on data obtained, mass emission rates were determined for the tetra-chlorinated through hepta-chlorinated homologues of the PCDDs and PCDFs. The dioxin emissions ranged from 4.3 nonograms per second (ng/sec) for tetrachloro dioxin (TCDD) to 270 (ng/sec) for the octachloro dioxin (OCDD). Furan emission rates ranged from 64.9 (ng/sec) for the tetrachloro furan to 319 (ng/sec) for the heptachloro furan. Polychlorinated biphenyls were not detected in the outlet gas stream samples.

44012 **(PB—87-204756/XAB) Evaluation test on a landfill gas-fired flare at the BKK Landfill Facility, West Covina, CA.** (California State Air Resources Board, Sacramento (USA). Stationary Source Div.). Jul 1986. 188p. (ARB/SS—87-09). NTIS, PC A09/MF A01.

A cooperative test program was conducted from March 3 through March 7, 1986, by Air Resources Board (ARB) and South Coast Air Quality Management District (SCAQMD) staff to evaluate the gaseous constituents from untreated landfill gas used to fuel a ground-level flare and the emissions from that flare located at the BKK Corporation Landfill in West Covina, California. The flare was fueled with gases generated by anaerobic decomposition of buried refuse at the landfill. Emissions of criteria pollutants, mass flow rates, and destruction removal efficiencies (DRE) of non-criteria pollutant compounds are presented. DREs for selected chlorinated and aromatic organic compounds determined from data from ARB resin samples ranged from 71 to 99+ percent for chlorinated compounds and from 60 to 99+ percent for aromatic compounds. Dioxins, furans, and polychlorinated biphenyls were not detected in the inlet nor the outlet gas stream samples.

44013 **(PB—87-204764/XAB) Evaluation test on a landfill gas-fired flare at the Los Angeles County Sanitation District's Puente Hills Landfill Facility.** (California State Air Resources Board, Sacramento (USA). Stationary Source Div.). Jul 1986. 162p. (ARB/SS—87-06). NTIS, PC A08/MF A01.

A cooperative test program was conducted from February 18 through February 21, 1986, by Air Resources Board (ARB) and South Coast Air Quality Management District (SCAQMD) staff to evaluate the gaseous constituents from untreated landfill gas used to fuel a flare at the County of Los Angeles Sanitation District's Puente Hills Landfill. The flare was fueled with gases generated by the anaerobic decomposition of buried refuse. Emissions of criteria pollutants as determined from ARB test data and mass flow rates and Destruction and Removal Efficiencies (DRE) of non-criteria pollutant compounds determined at the stack from SCAQMD test data are presented. Mass-flow rates and DREs for chlorinated and aromatic compounds determined from data from ARB resin samples are presented. Destruction and removal efficiencies based on mass flow rates for chlorinated compounds ranged from 35 to 99+ percent and for aromatic compounds ranged from four to 99+ percent. Dioxins, furans, and polychlorinated biphenyls were not detected in the inlet nor the outlet gas-stream samples.

44014 **(PB—87-205308/XAB) Evaluation test on a landfill gas-fired internal-combustion-engine system at the City of Glendale No. 1 Scholl Canyon Power Plant. Air pollution test report.** (California State Air Resources Board, Sacramento (USA). Stationary Source Div.). Jul 1986. 169p. (ARB/SS—87-08). NTIS, PC A08.

A cooperative test program was conducted from January 28 through January 31, 1986, by Air Resources Board (ARB) and South Coast Air Quality Management District (SCAQMD) staff to evaluate the gaseous constituents from untreated landfill gas used to fuel an internal combustion engine (ICE) and the emissions from that ICE located at the City of Glendale Scholl Canyon Power Plant. The ICE was fueled with gases generated by the anaerobic decomposition of buried refuse at the No. 1 Scholl Canyon Landfill operated by the City of Glendale, Public Service Department. The test was conducted as part of an ongoing program by the SCAQMD to allow assessment of the inlet fuel gas (landfill gas) and exhaust gas characteristics from such devices as ICEs, gas turbines, and flares. Emissions of criteria pollutants as determined from test data are reported. Mass flow rates and destruction and removal efficiencies (DRE's) of non-criteria pollutants compounds determined from SCAQMD bag sample test data and mass flow rates and DRE's for chlorinated and aromatic compounds determined from data from ARB resin samples are presented.

44015 **Formaldehyde sorption and desorption characteristics of gypsum wallboard.** Matthews, T.G.; Hawthorne, A.R.; Thompson, C.V. (Oak Ridge National Lab., TN). *Environmental Science and Technology;* **21**: No. 7, 629-634(Jul 1987).

The sorption and subsequent desorption of formaldehyde (CH_2O) vapor from unpainted gypsum wallboard have been investigated in environmental chamber experiments conducted at 23 °C, 50% relative humidity, an air exchange to board loading ratio of 0.43 m/h, and CH_2O concentrations ranging from 0 to 0.50 mg/m³. Both CH_2O sorption and CH_2O desorption processes are described by a three-parameter, single-exponential model with an exponential lifetime of 2.9 +/- 0.1 days. The storage capacity of gypsum board for CH_2O vapor results in a time-dependent buffer to changes in CH_2O vapor concentration surrounding the board but appears to cause only a weak, permanent loss mechanism for CH_2O vapor. Prior to significant depletion of sorbed CH_2O, desorption rates from CH_2O-exposed gypsum board exhibit a linear dependence with negative slope on CH_2O vapor concentration. Analogous CH_2O emissions properties have been observed for pressed-wood products bonded with urea-formaldehyde resins. 17 references, 5 figures.

44016 **Photooxidation of selected polycylic aromatic hydrocarbons and pyrenequiones coated by glass surfaces.** Cope, V.W.; Kalkwarf, D.R. (Battelle Pacific Northwest Lab., Richland, WA). *Environmental Science and Technology;* **21**: No. 7, 643-648(Jul 1987). Contract AC06-76RL01830.

Reactions of ozone with perylene, pyrene, and benzo[a]pyrene on glass surfaces exposed to simulated sunlight were studied. The ozonation rates of these hydrocarbons were increased only slightly by light intensities up to 1.3 kW/m²; however, the ozonation rates of the quinones, which result from pyrene ozonation, increased greatly. In the absence of ozone no photoreaction products of the three hydrocarbons could be detected. The photochemical ozonation rates of the pyrenequinones were proportional to their exposed surface area and to the concentration of ozone. The ozonation rate constant during exposure to simulated sunlight at 24 °C and $[O_3] = 6.2 \times 10^{-6}$ mol/m³ (0.16 ppm) was 8.2×10^{-4} s^{-1}, which is about 15 times greater than the comparable rate constant for the dark reaction. 32 references, 6 figures.

44017 **Indoor air pollution due to emissions from woodburning stoves.** Traynor, G.W.; Apte, M.G.; Carruthers, A.R.; Dillworth, J.F.; Grimsrud, D.T.; Gundel, L.A. (Lawrence Berkeley Lab., CA). *Environmental Science and Technology;* **21**: No. 7, 691-697(Jul 1987). Contract AC03-76SF00098.

Four wood-burning stoves, three airtight and one non-airtight, were operated in a single-floor 236-m³ residence and tested for indoor pollutant emissions. Results showed the airtight stoves emitted minor amounts of carbon monoxide and respirable suspended particles during door-opening operations, while the nonairtight stove continuously injected pollutants indoors under certain operating conditions. During airtight stove operation, carbon monoxide levels reached a maximum of 4 ppm, while average total suspended particulate levels ranged from 24 to 71 μg/m³. During normal non-airtight stove operation, carbon monoxide levels reached a maximum of 8 ppm, while total suspended particulate levels ranged from 30 to 650+ g/m³. Outdoor carbon monoxide levels were 1.1 ppm or less, and outdoor particulate levels ranged from 7 to 31 μg/m³. Five polycyclic aromatic hydrocarbons, including benzo[a]pyrene, were measured in the collected particulate samples, and the results are reported. Source strengths for carbon monoxide, total suspended particles, and five polycyclic aromatic hydrocarbons are reported. 26 references, 4 figures, 5 tables.

44018 **Polychlorinated biphenyl accumulation in tree bark and wood growth rings.** Meredith, M.L.; Hites, R.A. (Indiana Univ., Bloomington). *Environmental Science and Technology;* **21**: No. 7, 709-712(Jul 1987).

Polychlorinated biphenyls (PCBs) were found in the bark of black walnut and tulip poplar trees growing near a PCB-contaminated landfill. PCBs were also found in the bark of white oak trees growing 14 km away from the landfill. The concentration of individual congeners in the bark averaged 18 ppb at the landfill and 0.5 ppb at the other site. The PCB congeners were accumulated into the bark in proportion to their lipophilicity (as measured by octanol-water partition coefficients). The authors findings suggest that tree bark could be used for biomonitoring of lipophilic organic pollutants in the atmosphere. There is little evidence that PCBs are present in the wood of trees. The signal to blank ratios are always less than 3, and the relative concentrations between 20-year time intervals do not show trends that correlate with the known inputs of PCBs in Bloomington, IN. 2 tables.

44019 **Research review: Indoor air quality control techniques.** Fisk, W.J. (Indoor Environment Program, Lawrence Berkeley Lab., Berkeley, CA). pp 568-583 of IAQ '86: Managing indoor air for health and energy conservation. Atlanta, GA; American Society of Heating Refrigeration and Air Cond. (1986). (CONF-860446—). Contract AC03-76SF00098.

From Managing indoor air for health and energy conservation; Atlanta, GA, USA (20 Apr 1986).

Techniques for controlling the concentration of radon, formaldehyde, and combustion products in the indoor air are reviewed. The most effective techniques, which are generally based on limiting or reducing indoor pollutant source strengths, can decrease indoor pollutant concentrations by a factor of 3 to 10. Unless the initial ventilation rate is unusually low, it is difficult to reduce indoor pollutant concentrations more than approximately 50% by increasing the ventilation rate of an entire building. However, the efficiency of indoor pollutant control by ventilation can be enhanced through the use of local exhaust ventilation near concentrated sources of pollutants, by minimizing short circuiting of air from supply to exhaust when pollutant sources are dispersed and, in some situations, by promoting a displacement flow of air and pollutants toward the exhaust. Active air cleaning is also examined briefly.

44020 **Ventilation effectiveness measurements in an office building.** Persily, A.K. (Center for Building Technology, National Bureau of Standards, Gaithersburg, MD). pp 548-558 of IAQ '86: Managing indoor air for health and energy conservation. Atlanta, GA; American Society of Heating Refrigeration and Air Cond. (1986). (CONF-860446—).

From Managing indoor air for health and energy conservation; Atlanta, GA, USA (20 Apr 1986).

To evaluate the impact of ventilation on air quality within mechanically ventilated office buildings, one must examine both the outside air intake or ventilation rate and the performance of the air distribution system in delivering this outside air to the building occupants. Inadequate air distribution may lead to air quality problems, even if a building's total ventilation rate is adequate. Tracer gas measurement procedures have been developed to evaluate these air distribution characteristics of mechanical ventilation systems or their ventilation effectiveness. This paper examines the use of one such technique, tracer gas measurement employing age distribution analysis, in modern, mechanically ventilated office buildings.

44021 **Comparison of pollutant emission rates from unvented kerosene and gas space heaters.** Apte, M.G.; Traynor, G.W. (Indoor Environment Program, Lawrence Berkeley Lab., Univ. of California, Berkeley, CA 94720). pp 405-416 of IAQ '86: Managing indoor air for health and energy conservation. Atlanta, GA; American Society of Heating Refrigeration and Air Cond. (1986). (CONF-860446—). Contract AC03-76SF00098.

From Managing indoor air for health and energy conservation; Atlanta, GA, USA (20 Apr 1986).

A wide variety of unvented kerosene and gas space heaters are used in the United States. These include convective and radiant unvented kerosene space heaters and convective and infrared unvented gas space heaters (UVGSH). Unvented gas space heaters can be fueled by natural gas or propane. In addition, two-stage unvented kerosene space heaters have recently become available in the U.S. In this paper the pollutant emission rates of all five types of unvented space heaters are compared. Pollutant emission rates for carbon dioxide, carbon monoxide (CO), nitric oxide, nitrogen dioxide (NO/sub 2/), formaldehyde, and submicron suspended particles were measured. Special emphasis is placed on CO and NO/sub 2/ emissions. Pollutant measurements were made in a 27-m/sup 3/ (950 ft/sup 3/) environmental chamber, and emission rates were calculated using a mass-balance model. Emission rates for propane and natural gas space heaters were similar.

44022 **Background odor caused by previous tobacco smoking.** Clausen, G.H.; Moller, S.B.; Fanger, P.O.; Leaderer, B.P.; Dietz, R. (Lab. of Heating and Air Conditioning, Technical Univ. of Denmark). pp 119-125 of IAQ '86: Managing indoor air for health and energy conservation. Atlanta, GA; American Society of Heating Refrigeration and Air Cond. (1986). (CONF-860446—).

From Managing indoor air for health and energy conservation; Atlanta, GA, USA (20 Apr 1986).

The odor perceived in rooms where smoking occurs is a combination of odor from the present tobacco smoke and background odor caused partly by previous smoking. This background odor may have a substantial impact on the ventilation rate required for acceptable air quality. The intensity of the background odor may vary with ventilation, time, and preceding contamination of the room, but no earlier studies have investigated this. In the present field study, 32 judges evaluated the odor intensity, air freshness, and acceptability of the air upon entering ten different rooms, 7 to 22 hours after smoking in the rooms had ended. The rooms comprised bars, restaurants, canteens, and lecture rooms with different loads of tobacco smoking. Each room was evaluated twice with different ventilation rates. During the preceding smoking period, the average concentrations of particulate matter were measured. During and after the smoking, air infiltration rates were measured using passive perfluorocarbon tracer technique.

5003 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 43051, 43055, 43058, 43059, 43095, 43371, 43372, 43406, 43973, 44056

44023 **(CEA-R—5378) Study on the risk from indoor radon 220 and radon 222 exposures.** Rannou, A. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection Sanitaire). Dec 1986. 157p. (In French). NTIS (US Sales Only), PC A08/MF A01. File Number DE87752206.

The hazards from radon (radon 220 and 222) in dwelling atmospheres have been studied. In the first part devoted to the present state of the problem, an analysis is made of the formation mechanisms and the evolution of radon and its daughters indoors. The main physical and dosimetric quantities required for the risk evaluation are defined. The theoretical and experimental analysis of the methods of measurements of radon and its daughters used in the measurement campaign are considered in the second part. The progress and the result of the national survey are developed in the third part. The effects of several factors on indoor levels are discussed. The conclusions of a particular study in the Finistere "department" are presented. The data collected make it possible to assess the mean exposure of man to natural radiation.

44024 **(DOE/EV/13573—5) The fate of nuclides in natural water systems: Final report, April 1, 1984-April 30, 1987.** Turekian, K.K. (Yale Univ., New Haven, CT (USA). Dept. of Geology and Geophysics). 1987. Contract AC02-76EV13573. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013692.

Research in the following areas is described: (1) the fluxes of ^{10}Be, ^{90}Sr, and ^{210}Pb were measured and the worldwide ^{10}Be cosmic ray production rate determined; (2) the origin of ground level aerosols was determined by the ratio of ground-derived ^{210}Pb

to stratosphere-derived ^{137}Cs; (3) a material balance for ^{210}Pb in the Middle Atlantic Bight (MAB) was derived; (4) sediment studies of ^{210}Pb and ^{137}Cs distributions along the SEEP traverse; (5) ^{210}Pb profiles from the Atlantic sector of the Southern Ocean; and (6) carbon balance and coastal oceanography using radiocarbon analysis of water, shells, and sediments. (ACR)

44025 **(DOE/OR/20722—145) St. Louis Airport site: Annual site environmental report, Calendar Year 1986.** (Bechtel National, Inc., Oak Ridge, TN (USA)). May 1987. Contract AC05-81OR20722. 61p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87009533.

During 1986, the environmental monitoring program was continued at the St. Louis Airport Site (SLAPS) in St. Louis County, Missouri. The ditches north and south of the site were designated for cleanup as part of the Formerly Utilized Sites Remedial Action Program (FUSRAP), a United States Department of Energy (DOE) program to identify, decontaminate, or control sites where residual radioactive material remains from the early years of the nation's atomic energy program. The site is currently controlled by the St. Louis Airport Authority. The monitoring program measures radon gas concentrations in air; external gamma dose rates; and uranium, thorium, and radium concentrations in surface water, groundwater, and sediment. The radiation dose was calculated for the maximally exposed individual. Based on the scenario described in this report, the maximally exposed individual would receive an external exposure approximately equivalent to 4.7 percent of the DOE radiation protection standard of 100 mrem/yr. The dose to the population within an 80-km (50-mi) radius of the SLAPS that would result from radioactive materials present at the site would be indistinguishable from the dose the population would receive from naturally occurring radioactive sources. 12 refs., 5 figs., 10 tabs.

44026 **(EML—459) Positive random variables with a discrete probability mass at the origin: Parameter estimation for left-censored samples with application to air quality monitoring data.** Gogolak, C.V. (USDOE Environmental Measurements Lab., New York). Nov 1986. 241p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE87013826.

The concentration of a contaminant measured in a particular medium might be distributed as a positive random variable when it is present, but it may not always be present. If there is a level below which the concentration cannot be distinguished from zero by the analytical apparatus, a sample from such a population will be censored on the left. The presence of both zeros and positive values in the censored portion of such samples complicates the problem of estimating the parameters of the underlying positive random variable and the probability of a zero observation. Using the method of maximum likelihood, it is shown that the solution to this estimation problem reduces largely to that of estimating the parameters of the distribution truncated at the point of censorship. The maximum likelihood estimate of the proportion of zero values follows directly. The derivation of the maximum likelihood estimates for a log-normal population with zeros is given in detail, and the asymptotic properties of the estimates are examined. The estimation method was used to fit several different distributions to a set of severely censored ^{85}Kr monitoring data from six locations at the Savannah River Plant chemical separations facilities.

44027 **(EML—479) The July 1985 and March 1986 radon intercomparisons at EML [Environmental Measurements Laboratory].** Fisenne, I.M.; George, A.C.; Keller, H.W. (USDOE Environmental Measurements Lab., New York). Mar 1987. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013829.

This report summarizes the results of the July 1985 and March 1986, the ninth and tenth, radon intercomparison exercises held at the Environmental Measurements Laboratory. Twenty-eight organizations including US Federal facilities, national and state laboratories, universities, commercial facilities and non-US laboratories participated in these exercises. The results indicate that the majority of the participants were within +-25% of the nominal value at a ^{222}Rn concentration level of 70 pCi L^{-1}. Observations regarding the reliability of several sampler types and the most common sources of measurement and calculation errors are also enumerated.

44028 **(EUR—10036) Measures of environmental radioactivity - Ispra 1984.** Dominici, G. (Commission of the European Communities, Ispra (Italy). Joint Research Centre; Commission of the European Communities, Luxembourg). 1985. 52p. (In Italian). Commission of the European Communitties, Luxembourg.

In this report there are briefly described the measurements of environmental radioactivity performed during 1984 by the site survey group of the Radioprotection Division at the Joint Research Centre Ispra Establishment. Data are given on the concentrations of /sup 90/Sr, /sup 137/Cs, and other radionuclides in precipitation, air, waters, herbage, milk and radioactive effluents. The environmental contamination is mainly world-wide fall-out.

44029 **(NUREG/CR—4779) New data for aerosols generated by releases of pressurized powders and solutions in static air.** Ballinger, M.Y.; Sutter, S.L.; Hodgson, W.H. (Pacific Northwest Lab., Richland, WA (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Fuel Cycle, Medical, Academic and Commercial Use Safety). May 1987. Contract AC06-76RL01830. 49p. (PNL—6065). NTIS, PC A03/MF A01 - GPO. File Number TI87010941.

Safety assessments and environmental impact statements for nuclear fuel cycle facilities require an estimate of potential airborne releases. Aerosols generated by accidents are being investigated by Pacific Northwest Laboratory to develop radioactive source-term estimation methods. Experiments measuring the mass airborne and particle size distribution of aerosols produced by pressurized releases were run. Carbon dioxide was used to pressurize uranine solutions to 50, 250, and 500 psig before release. The mass airborne from these experiments was higher than for comparable air-pressurized systems, but not as great as expected based on the amount of gas dissolved in the liquid and the volume of liquid ejected from the release equipment. Flashing sprays of uranine at 60, 125, and 240 psig produced a much larger source term than all other pressurized releases performed under this program. Low-pressure releases of depleted uranium dioxide at 9, 17.5, and 24.5 psig provided data in the energy region between 3-m spills and 50-psig pressurized releases.

44030 **(PB—87-198362/XAB) Review of the Canadian and Swedish experience for the control of indoor radon. Published paper.** Sanchez, D.C. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). Jun 1987. 19p. (EPA—600/D-87/181). NTIS, PC A02/MF A01.

The paper reviews Canadian and Swedish experience in controlling indoor radon. Interest in and concern about elevated levels of radon (Rn) and radon daughters (RnD) in the indoor environment have been growing steadily during the last 10 years. During this period the federal governments of Canada and Sweden, in conjunction with provincial authorities, have developed a coordinated response or program for reducing the national health risk of indoor Rn/RnD exposure. The focus of these programs is on characterizing and/or locating the problem areas or dwellings, and providing demonstrated control approaches to deal with the indoor Rn/RnD problem. The investigations by Canada and Sweden have identified numerous control approaches that are effective when they are applied appropriately and carefully. Among these control technqiues are the use of subfloor (depressurization) ventilation, crawlspace ventilation, house ventilation, and new construction practices such as monolithic pours with floor/wall joint sealing.

44031 **(PNL-SA—14250) In-situ gamma-ray measurements in the Chernobyl plume.** Lepel, E.A.; Hensley, W.K.; Boatman, J.F.; Busness, K.M.; Davis, W.E.; Robertson, D.E.; Slinn, W.G.N. (Pacific Northwest Lab., Richland, WA (USA); National Oceanic and Atmospheric Administration, Boulder, CO (USA)). Mar 1987. Contract AC06-76RL01830. 28p. (CONF-870430—12). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011139.

From International conference on methods and applications of radioanalytical chemistry; Kona, HI, USA (5 Apr 1987).

Airborne gamma-ray measurements were made aboard the Pacific Northwest Laboratory (PNL) DC-3 and the National Oce-

anic and Atmospheric Administration (NOAA) King Air research aircraft before and during the first passage of the Chernobyl radioactive cloud over the west coast of the North American continent. Measurements were made from Anchorage, Alaska south to Reno, Nevada. Calculated trajectories were used to estimate the location of the Chernobyl plume. The in-situ gamma-ray analysis systems first detected the cloud on May 8, 1986. Subsequent analysis of concurrently collected air filters indicate that the leading edge of the plume was just reaching the west coast of the United States on May 6, 1986. The ratios of the observed volatile radionuclides (^{131}I and ^{134}Cs) relative to ^{137}Cs agreed with the reported discharge ratio.

44032 **(PNL-SA—15051) Some data reduction and evaluation methods for environmental radionuclide data.** Gilbert, R.O. (Pacific Northwest Lab., Richland, WA (USA)). 1 Jun 1987. Contract AC06-76RL01830. 20p. (CONF-870791—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013327.

From Annual health physics summer school; Pocatello, ID, USA (12 Jul 1987).

This paper gives some practical statistical methods for the analysis and evaluation of environmental radionuclide data. The methods discussed here include several for: (1) relating objectives to statistical design; (2) testing for normal and lognormal distributions; (3) number of samples required to estimate a mean or geometric mean; (4) estimating the mean and geometric mean of a lognormal distribution; and (5) detecting and estimating trends. (ACR)

5006 Regulations

REFER ALSO TO CITATION(S) 43054, 43486, 43491, 43991, 44085

44033 **(ORNL/M—382) Air emission permits at the Oak Ridge National Laboratory.** Dumont, J.N. (Oak Ridge National Lab., TN (USA)). Aug 1987. Contract AC05-84OR21400. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013524.

This report documents the status of air emission operating and construction permitting activities of the Oak Ridge National Laboratory since 1977. Ninety-four air emission permits have been issued to the laboratory by the Tennessee Department of Health and Environment (TDHE) since 1977. Sixty applications submitted to TDHE are pending approval. Eight operating permits and 33 construction permits have expired (these have been renewed where appropriate). One hundred and thirty-one formal applications have been submitted to TDHE since 1977.

44034 **(PB—87-192787/XAB) Coke oven emissions from wet-coal charged by-product coke oven batteries - background information for proposed standards. Draft environmental impact statement.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Apr 1987. 487p. (EPA—450/3-85/028A). NTIS, PC A21/MF A01.

National emission standards to control coke oven emissions from new and existing wet-coal charged by-product coke-oven batteries are being proposed under Section 112 of the Clean Air Act. The standards apply to charging, topside, and door leaks. The document contains information on the background and authority, emission control techniques, regulatory alternatives considered, and the economic and health impacts associated with the proposed standards.

44035 **(PB—87-195624/XAB) Polymeric coating of supporting substrates--background information for proposed standards. Draft environmental impact statement.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Emission Standards and Engineering Div.). Apr 1987. 313p. (EPA—450/3-85/022A). NTIS, PC A14/MF A01.

Standards of performance for the control of VOC emissions from the polymeric coating of supporting substrates are being proposed under the authority of Section III of the Clean Air Act. These standards would apply to all new, modified, or reconstructed polymeric coating lines using at least 110 cubic meters of solvent per year in the production of polymeric-coating supporting substrates. The document contains background information and environmental and economic impact assessments of the regulatory alternatives considered in developing the proposed standards.

51 ENVIRONMENTAL SCIENCES, TERRESTRIAL

5101 Basic Studies

REFER ALSO TO CITATION(S) 43165, 44111, 44112, 44113, 44114, 44115, 44185

44036 **(DOE/CH/00085—T1) The influence of thermal energy exchange on the activity and energetics of yellow-bellied marmots.** Melcher, J.C. (Kansas Univ., Lawrence (USA)). 1987. Contract AA02-78CH00085. 121p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87013667.

The energetics of yellow-bellied marmots (Marmota flaviventris), large hibernating ground squirrels were investigated. Marmots typically inhabit montane regions with short growing seasons. Minimization of energy expenditure by hibernation is essential for overwinter survival, whereas maximization of energy intake is important during the active season. Marmots near the Rocky Mountain Biological Laboratory in southwestern Colorado are active for only 4 to 5 months each year. During this time they must reproduce, grow, and store enough fat to survive hibernation. 64 refs., 13 figs., 10 tabs.

44037 **(DOE/ER—0156/4) Subsurface transport program: Research summary.** (USDOE Office of Energy Research, Washington, DC. Ecological Research Div.). Jan 1987. 51p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87013771.

DOE's research program in subsurface transport is designed to provide a base of fundamental scientific information so that the geochemical, hydrological, and biological mechanisms that contribute to the transport and long term fate of energy related contaminants in subsurface ecosystems can be understood. Understanding the physical and chemical mechanisms that control the transport of single and co-contaminants is the underlying concern of the program. Particular attention is given to interdisciplinary research and to geosphere-biosphere interactions. The scientific results of the program will contribute to resolving Departmental questions related to the disposal of energy-producing and defense wastes. The background papers prepared in support of this document contain additional information on the relevance of the research in the long term to energy-producing technologies. Detailed scientific plans and other research documents are available for high priority research areas, for example, in subsurface transport of organic chemicals and mixtures and in the microbiology of deep aquifers. 5 figs., 1 tab.

5102 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 42968, 43060, 43087, 43208, 43406, 44012, 44013, 44014, 44037, 44049, 44057, 44058, 44117, 44118, 44120, 44121, 44124, 44125, 44183, 44210, 44221

44038 **(CONF-8705159—1) Products of the neutralization of hydrazine fuels with hypochlorite: II.** Brubaker, K.L.; Bonilla, J.; Stamoudis, V.C.; Boparai, A.S.; Snyder, C.T. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 7p. NTIS, PC A02. File Number DE87011454.

From JANNAF Safety and Environmental Protection subcommittee meeting; Cleveland, OH, USA (5 May 1987).

Neutralization of hydrazine fuels with hypochlorite is a recommended procedure for the treatment of fuel spills prior to disposal. Previous research has shown that incomplete reaction of hypochlorite with the methylated hydrazine fuels monomethylhydrazine (MMH) and unsymmetrical dimethylhydrazine (UDMH) leads

to a wide variety of byproducts, including N-nitrosoamines, which are believed to be highly carcinogenic. The results presented in this paper were obtained as part of a program to assess the environmental implications of using the hypochlorite method for the treatment and disposal of hydrazine fuel spills. The fuels examined were hydrazine, MMH, UDMH and Aerozine-50. The neutralization products were determined under experimental conditions comparable to those expected for actual spills. The effects of varying the temperature and the pH as well as of aging the final reaction mixture were determined. Quantitative measurements of the nitrosoamines produced are presented. Major and environmentally significant minor products were identified using gas chromatography/mass-spectrometry.

44039 **(DPST—85-697) Savannah River Laboratory Oil Test Site: Environmental information document.** Johnson, W.F.; Pickett, J.B.; Bledsoe, H.W. (Savannah River Lab., Aiken, SC (USA)). Dec 1986. Contract AC09-76SR00001. 56p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87013038.

The Savannah River Laboratory (SRL) Oil Test Site is located approximately 600 m south of the Central Shops complex at the Savannah River Plant (SRP). This site was used to study the biodegradation of machine cutting oil with a viscosity similar to a heavy automotive engine oil. The SRL biodegradation study involved a total of 9960 L of waste oil, which was spread over 12 test plots, with the test plots composing a total area of 475 m^2. The oil was applied in 1975. In 1976, two additional plots were used to dispose of hydraulic fluid and paint thinner. A total of 7300 L of these materials was spread over an area of 400 m^2 on these plots. Soil tests conducted between 1975 and 1980 indicated that the waste oil had not migrated below 30 cm from ground surface. Nearly 50% of the oil was lost to volatilization and biodegradation after two years. Groundwater at the SRL Oil Test Site has not been evaluated. The closure options considered for the site are waste removal and closure, no waste removal and closure, and no action. No human health risk calculations were performed for this site because there were no materials disposed at this site that were identified as presenting a health or environmental risk. A cost estimate for each closure option was prepared. The cost analysis shows that the removal of surface soils from the SRL Oil Test Site and disposal in the SRP Sanitary Landfill is less expensive than clay capping and monitoring for 30 years (by 10X) and no action with monitoring for 30 years (by 4X).

44040 **(DPST—85-705) Acid/Caustic Basins: Environmental information document.** Ward, J.W.; Johnson, W.F.; Marine, I.W. (Savannah River Lab., Aiken, SC (USA)). Dec 1986. Contract AC09-76SR00001. 216p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE87013047.

There are six Acid/Caustic Basins at SRP, all of which are located in the reactor and separations areas. These basins are unlined earthen depressions with nominal dimensions of 15.2 m in length x 15.2 m in width x 2.1 m in depth. They were used to provide mixing and partial neutralization of dilute sulfuric acid and sodium hydroxide solutions from water treatment facilities before these solutions were discharged to tributaries of local streams. Closure options considered for the Acid/Caustic Basins are waste removal and closure, no waste removal and closure, and no action. The predominant pathways for human exposure to chemical contaminants are through surface, subsurface, and atmospheric transport. Modeling calculations were made to determine the risks to human population via general pathways for the three postulated closure options. A cost estimate for each closure was also made.

44041 **(EPRI-EA—5322-SR) Solid-Waste Environmental Studies (SWES): Description, status, and available results.** Murarka, I.P.; McIntosh, D.A. (Electric Power Research Inst., Palo Alto, CA (USA)). Aug 1987. 84p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920541.

This report presents the description and status of ongoing research and available results from the Solid Waste Environmental Studies (SWES) research project organized by research area. SWES is a multiyear, multifaceted research project aimed at developing, validating and delivering methods and information to accurately assess ground water quality changes. The focus of SWES research is on inorganic chemicals from utility industry solid waste disposal facilities. The products of the SWES project are diverse ranging from data and evaluations to complex hydrogeochemical models and validated prediction methods. Each section in this report covers specific objectives of the research area, including how the research is being conducted, what has been completed, what information is currently available, and what is the remaining and planned research. Research areas discussed are: (1) Leaching Chemistry Studies; (1) Chemical Attenuation Studies; (3) Subsurface Transport Studies; (4) Geohydrochemical Models Evaluation and Interim Development; (5) Field Sampling Methods Evaluation and Improvement; (6) Development of improved geohydrochemical models; and (7) Field validation of prediction methods.

44042 **(ORNL/TM—10296) Identification of technical guidance related to ground water monitoring.** Vogelsberger, R.R.; Smith, E.D.; Broz, M.; Wright, J.C. Jr. (International Technology Corp., Monroeville, PA (USA); Oak Ridge National Lab., TN (USA)). May 1987. Contract AC05-84OR21400. 211p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE87013374.

Monitoring of ground water quality is a key element of ground water protection and is mandated by several federal and state laws concerned with water quality or waste management. Numerous regulatory guidance documents and technical reports discuss various aspects of ground water monitoring, but at present there is no single source of guidance on procedures and practices for ground water monitoring. This report is intended to assist US Department of Energy (DOE) officials and facility operating personnel in identifying sources of guidance for developing and implementing ground water monitoring programs that are technically sound and that comply with applicable regulations. Federal statutes and associated regulations were reviewed to identify requirements related to ground water monitoring, and over 160 documents on topics related to ground water monitoring were evaluated for their technical merit, their utility as guidance for regulatory compliance, and their relevance to DOE's needs. For each of 15 technical topics involved in ground water monitoring, the report presents (1) a review of federal regulatory requirements and representative state requirements, (2) brief descriptions of the contents and merits of available guidance documents and technical references, and (3) recommendations of the guidance documents or other technical resources that appear to be most appropriate for use in DOE's monitoring activities. The contents of the report are applicable to monitoring activities involving both radioactive and nonradioactive substances. The main sources of regulatory requirements considered in the report are the Atomic Energy Act (including the Uranium Mill Tailings Radiation Control Act), Resource Conservation and Recovery Act, Comprehensive Environmental Response, Compensation and Liability Act, Safe Drinking Water Act, Toxic Substances Control Act, and Federal Water Pollution Control Act.

44043 **(PB—87-198701/XAB) Retrospective evaluation of the effects of selected industrial wastes on municipal-solid-waste stabilization in simulated landfills.** Pohland, F.G.; Harper, S.R. (Georgia Inst. of Tech., Atlanta (USA). School of Civil Engineering). Jun 1987. 251p. NTIS, PC A12/MF A01.

The report is a retrospective evaluation of ten years of leachate and gas data collected from 19 simulated landfills (landfill cells) containing municipal solid waste codisposed with sewage sludge or industrial wastes. Physical and chemical parameters from each landfill cell are compared to conceptualized landfill stabilization patterns in order to identify those cells that achieved rapid biological stabilization (RBS). Selected leachate and gas constituent concentrations are also compared between cells in order to draw conclusions regarding the influence of codisposed wastes and other variables on landfill performance.

44044 **(PB—87-198842/XAB) Effect of the quantity and duration of application of simulated acid precipitation on nitrogen mineralization and nitrification in a forest soil.** Klein, T.M.; Alexander, M. (Cornell Univ., Ithaca, NY (USA). Dept. of Agronomy). 1986. 11p. NTIS, PC A02/MF A01.

Pub. in Water, Air and Soil Pollution, Vol. 28, 309-318(Apr 1986).

A study was conducted of the influence of the rate of application of simulated acid rain on N mineralization and nitrification in a forest soil. The rates were varied by applying different quantities of simulated rain for varying periods of time. The soil was exposed in the laboratory to simulated rain at pH 3.5, 4.1,, or 5.6 at rates equivalent to 1.5, 2.3, 4.6, 7.1 or 15 times the average rate of precipitation in the field and then mineralization of soil N or oxidation of added ammonium was determined. The rates of N mineralization were inhibited by precipitation at pH 3.5 or 4.1 when applied for 27-234 days at rates 1.5 times greater than that which occurs in nature. N mineralization was not affected by simulated rain at pH 3.5 or 4.1 in soils exposed for 156 days at 2.3 times the natural rate of precipitation, for 27 or 81 days at 4.6 times the natural rate, for 54 days at 7.1 times the natural rate, or for 234 day at 15 times the natural rate. (Copyright (c) 1986 by D. Reidel Publishing Company).

44045 **(PB—87-205357/XAB) Predicting chemical movement in soils. Technical completion report.** O'Connor, G.A.; Khorsandi, F. (New Mexico State Univ., Las Cruces (USA). New Mexico Water Resources Research Inst.). Jan 1987. 31p. (WRRI-M—17). NTIS, PC A03/MF A01.

Chemical Movement In Soil (CMIS) is a management/educational computer model that provides qualitative predictions of pesticide fate as a function of key soil, chemical, and climatic variables. Model assumptions limit it to nonpolar pesticides (and other xenobiotics) moving in sandy soils. The purpose of the work was to test and modify the model for chemicals and soils pertinent to New Mexico. Laboratory column studies with a sandy New Mexico soil matched reasonably well with model predictions.

44046 (SRO—819-17, pp 63-67) **Potential cation leaching losses following disturbance across a southeastern Coastal Plain landscape gradient.** Kovacic, D.A.; McLeod, K.W.; Leff, A.A.; Ciravolo, T.G. Sep 1986. NTIS, PC A09/MF A01. File Number DE87012054.

In Ecological research at the Savannah River Ecology Laboratory: Annual report for the period ending July 31, 1986.

The purpose of this study was to compare the effects of forest disturbance on potential solution cation (K, Ca, Al, Fe, Mg and Mn) losses between upland and wetland vegetative community types along a landscape gradient on the Upper Coastal Plain of South Carolina. The habitats studied were: upland pine forest, upland deciduous forest, bottomland deciduous forest and cypress swamp. Trenching was a controlled disturbance that allowed the authors to assess the effects of interrupting root uptake, without changing the microclimate and with minimum disturbance of the forest floor. Studies have used trenching to determine the importance of root uptake on nutrient cycling in forest ecosystems, but few have compared these processes across vegetative community types of close proximity along a landscape gradient. 2 figures, 1 table.

5103 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 43044, 43045, 43046, 43047, 43048, 43049, 43051, 43052, 43055, 43058, 43059, 43060, 43082, 43084, 43087, 43089, 43091, 43092, 43093, 43094, 43095, 43096, 43098, 43104, 43105, 43106, 43406, 44025, 44028, 44032, 44037, 44059, 44149

44047 **(DOE/ID/12584—1) Investigation of the Hammer-Gamma measurement technique: A feasibility study.** Showalter, R. (UNC Geotech, Grand Junction, CO (USA)). May 1987. Contract AC07-86ID12584. 20p. (UNC/GJ—31-TMC). NTIS, PC A02/MF A01; GPO Dep. File Number DE87010853.

As a reconnaissance tool for the determination of the approximate extent of shallow subsurface radium contamination, various detectors were evaluated to determine the most appropriate size for use in this task. Measurements were taken in the calibration models with existing instrumentation to determine sensitivities and calibration factors. Field measurements were taken to ensure subsurface contamination could be located with the instrumentation selected. Various methods of constructing a slim and shallow borehole were investigated to determine the easiest and quickest method of inserting the detector into the ground. Based on these investigations, a prototype "Hammer-Gamma" system was designed, built, and tested. 7 refs., 4 figs., 4 tabs.

44048 **(DOE/NV/10471—T1) The removal of plutonium contaminants from Rocky Flats Plant soil.** Sunderland, N.R. (AWC, Inc., Las Vegas, NV (USA)). 27 May 1987. Contract AC08-86NV10471. 65p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87010781.

This research was undertaken to determine if the TRUclean process could effectively remove radioactive elements from soils other than derived coral. This is an interim report prior to the project report and discusses the outcome of the tests of the Rocky Flats Plant (RFP) soil. The soil tested contained plutonium particulates in the micron and submicron range. Volume reduction and activity removal were accomplished with an overall efficiency of greater than 90%. The TRUclean process is a very practical and economical solution to soil contamination problems at the Rocky Flats Plant.

44049 **(DPST—86-291) Selection of chemical constituents and estimation of inventories for environmental analysis of Savannah River Plant waste sites: Environmental information document.** Looney, B.B.; Pickett, J.B.; King, C.M.; Holmes, W.G.; Johnson, W.F.; Smith, J.A. (Savannah River Lab., Aiken, SC (USA)). Mar 1987. Contract AC09-76SR00001. 207p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE87013052.

Chemical constituents which have been disposed of at SRP facilities are identified and inventories estimated. These estimates are to be used in assessing the environmental impact of various waste management options at the Savannah River Plant. Several types of data were used in selecting the significant constituents including: (1) groundwater data (where available), (2) soil core data beneath the site (where available), (3) estimates of disposal based on periodic influent measurements (where available), and (4) estimates based on process records (where available). These same data were used to estimate the mass of chemical to be assessed. A simple dynamic mass balance model was used to determine the relative fractions of volatile organic constituents and tritium which volatilized to the air versus seeped into the ground. Materials selected for assessment, estimated mass disposed, and important assumption are tabulated for each functional group of waste sites.

44050 **(EML—457) Worldwide deposition of ^{90}Sr through 1984.** Larsen, R.J.; Juzdan, Z.R. (USDOE Environmental Measurements Lab., New York). Oct 1986. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013825.

The deposition of ^{90}Sr in the Northern Hemisphere during 1984 was 0.3 PBq (0.008 MCi), while that of the Southern Hemisphere was 0.1 PBq (0.003 MCi). This resulted in a total deposition on the surface of the earth during 1984 of 0.4 PBq (0.011 MCi). This is the lowest total yearly deposit since the initiation of the Environmental Measurements Laboratory's global fallout program in the mid-1950's. The worldwide cumulative deposit decreased to 357 PBq (9.6 MCi).

44051 **(ORNL/TM—10006) Radiological survey of Latty Avenue in the vicinity of the former Cotter site, Hazelwood/Berkeley, Missouri (LM001).** Cottrell, W.D.; Carrier, R.F. (Oak Ridge National Lab., TN (USA)). May 1987. Contract AC05-84OR21400. 257p. NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE87013376.

A radiological survey was conducted over a proposed construction corridor in the vicinity of the former Cotter site at 9200 Latty Avenue. The survey included gamma exposure rates at the ground surface and at 1 m above the surface throughout the site, sampling of surface soil, sampling of subsurface soil from auger holes, gamma logging of auger holes, and sampling of subsurface water. The results of the survey demonstrated some degree of radioactive contamination in all areas of the construction corridor, extending north and south in some regions onto adjacent private properties. Redistribution of the contamination by flooding, surface runoff, and road and utility line activities was evident. The pattern

of contamination ranged from widespread to isolated spots and was found to occur from near the surface to depths of ~1.8 m. The most highly contaminated region was noted on both sides of Latty Avenue adjacent to the former Cotter site. Concentrations of ^{230}Th in soil from that region were as high as 16,000 pCi/g.

44052 **(ORNL/TM—10008) Radiological survey of properties in the vicinity of the former Cotter site, Hazelwood/ Berkely, Missouri (LM003).** Cottrell, W.S.; Carrier, R.F.; Johnson, C.A. (Oak Ridge National Lab., TN (USA)). May 1987. Contract AC05-84OR21400. 110p. NTIS, PC A06/ MF A01; 1; GPO Dep. File Number DE87001910.

A radiological survey was conducted in 1984 by the Oak Ridge National Laboratory of private properties adjacent to the former Cotter site at 9200 Latty Avenue, Hazelwood/Berkeley, Missouri. During the 1960s and 1970s, process wastes and residues generated by the production and refining of uranium materials were stored at the site. Subsequent to the removal and transport of the stored wastes, along with a portion of the top soil, to other locations, it was found that the soil remaining on the site contained radioactive residuals. This report describes the survey of the properties adjacent to the site. Included were gamma exposure rates at the ground surface and at 1 m above the surface throughout the site; sampling of surface soil; sampling of subsurface soil from auger holes; gamma logging of auger holes; and, sampling of sediment and surface waters receiving drainage from the site. The results of the survey demonstrated some degree of radioactive contamination over most of the area surveyed. The major contaminant was ^{230}Th with ^{226}Ra and ^{238}U occurring in lesser amounts. The maximum concentrations of ^{226}Ra, ^{230}Th, and ^{238}U found in soil were 1400, 81,000, and 990 pCi/g, respectively. The maximum depth at which contamination was measured was 2 m. Although samples of drainage waters showed no evidence of contamination, migration of the radioactive materials was indicated by elevated concentrations of ^{226}Ra, ^{230}Th, and ^{238}U in sediment samples taken from those waters. The pattern of radionuclide contamination observed in most soil and sediment samples is typical of the wastes and residues which had been stored at the former Cotter site. 9 refs., 4 figs., 8 tabs.

44053 **(UCRL—96724) Excess ^{129}Xe in terrestrial samples: A non-primordial hypothesis.** Caffee, M.W.; Hudson, G.B. (Lawrence Livermore National Lab., CA (USA)). Mar 1987. Contract W-7405-ENG-48. 20p. (CONF-870396—2). NTIS, PC A02. File Number DE87010810.

From Lunar and planetary science conference; Houston, TX, USA (16 Mar 1987).

Excesses of ^{129}Xe relative to the isotopic composition in air are observed in some terrestrial samples. Traditionally these ^{129}Xe excesses have been thought to be related to ^{129}I that was present in abundance in the early solar system. We propose an alternative hypothesis to explain terrestrial ^{129}Xe excesses based on the production of ^{129}I from the spontaneous fission of ^{238}U.

44054 **(YJT—86-27) Sorption and diffusion of cobalt, nickel, strontium, iodine, cesium and americium in natural fissure surfaces and drill core cups studied by autoradiography, 2.** Suksi, S.; Kaemaeraeinen, E.L.; Jaakkola, T.; Ervanne, H.; Lindberg, A. (Voimayhtioeiden Ydinjaetetoimikunta, Helsinki (Finland)). Sep 1986. 38p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87752416.

Theoretical studies on geological disposal of radioactive waste in fractured crystalline rock and migration of radionuclides in groundwater circulating through the fractured zones have indicated the importance of diffusion into the rock matrix. Samples chosen for this study were filled and unfilled natural fracture surfaces and drill cores having a central drilled cavity ('drill core cups'). Samples originated from the two nuclear power plant sites in Finland: mica gneiss and tonalite from Olkiluoto and rapakivi granite from Haestholmen in Loviisa. An autoradiographic method was used for determination of the penetration depths and calculation of diffusion coefficients of Cs-134, Sr-90, Co-60, Ni-63, I-125 and Am-241. Emphasis was also directed to testing the quantitative autoradiographic method for diffusion coefficient measurements. After one year's contact time the penetration depths of strontium in tonalite were 15 mm and 10 mm for the filled and unfilled natural fracture surface samples and 5 mm for drill core cups. In the filled natural fracture surface sample of rapakivi granite the penetration depth of strontium was 35 mm. For cesium penetration depths in tonalite from 2.0 mm (unfilled natural surface) to 3.0 mm (drill core cup) were observed. For cobalt a penetration depth of 0.9 mm was found in the drill core cup sample of tonalite after contact time of one year and 1.5 mm in the filled natural fracture surface of rapakivi granite after contact time of six months. The range of D/sub a/-values of strontium was 1.4 x 10/sup -14/ - 1.1 x 10/sup -13/ m/sup 2//s. The D/ sub a/-values for cesium and cobalt in tonalite (drill core cup samples) were 7 x 10/sup -15/ m/sup 2//s and 5 x 10/sup -16/ m/sup 2//s, respectively.

5104 Thermal Effluents Monitoring And Transport

REFER ALSO TO CITATION(S) 44060, 44061, 44062, 44063, 44151

5105 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 42960, 42965, 42966, 43057, 43087, 43096, 44039, 44048, 44049, 44149, 44151

44055 **(DOE/ID—12109) Publications of the Idaho National Engineering Laboratory Radioecology and Ecology Program: 1974-1986.** Reynolds, T.D.; Markham, O.D. (comps.). (USDOE Radiological and Environmental Sciences Lab., Idaho Falls, ID). Jun 1987. Contract AC07-76ID01570. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013846.

The Radioecology and Ecology Program has produced a total of 32 Master's Theses, 11 Ph.D. Dissertations, 36 technical reports, 147 technical publications in refereed journals, and 6 popular articles since 1974. This report chronologically lists the citation of each of these documents. Individual annual progress reports, safety review documents, and other similar manuscripts resulting from Radioecology and Ecology Program research are excluded from the list.

44058 **(DOE/OR/01405—T1) Annual environmental monitoring summary for RMI Company, Extrusion Plant, Ashtabula, Ohio, January 1, 1986 through December 31, 1986.** (RMI Co., Ashtabula, OH (USA). Extrusion Plant). 1986. Contract AC05-76OR01405. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010944.

This report summarizes environmental monitoring activities including test results for stack discharges, perimeter air samples, wastewater discharges, offsite soil monitoring and Fields Brook sediment sampling, and ground water monitoring. Results compared to applicable standards indicate that all operations are in substantial compliance with these standards.

44057 **(DPST—85-691) Metals Burning Pit, Miscellaneous Chemical Basin: Environmental information document: Final draft.** Pickett, J.B.; Bledsoe, H.W.; Muska, C.F.; Marine, I.W. (Savannah River Lab., Aiken, SC (USA)). Dec 1986. Contract AC09-76SR00001. 111p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87013035.

This document provides environmental information on postulated closure options for the Metals Burning Pit and the Miscellaneous Chemical Basin at the Savannah River Plant and was developed as background technical documentation for the Department of Energy's proposed Environmental Impact Statement (EIS) on waste management activities for groundwater protection at the plant. The results of groundwater and atmospheric pathway analyses, accident analysis, and other environmental assessments discussed in this document are based upon a conservative analysis of all foreseeable scenarios as defined by the National Environmental Policy Act (40 CFR 1500-1508). The scenarios do not necessarily represent actual environmental conditions.

44058 **(DPST—85-702) Silverton Road Waste Site: Environmental information document.** Corbo, P.; Scott, S.C.; Killian, T.H.; Kolb, N.L.; Bledsoe, H.W. (Savannah River Lab., Aiken, SC (USA)). Dec 1986. Contract AC09-76SR00001. 167p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87013039.

The Silverton Road Waste Site at the Savannah River Plant (SRP) was used for disposal of metal shavings, construction debris, tires, drums, tanks, possibly asbestos, and miscellaneous items. The startup date is unknown, no records of waste disposal activities have been kept, and the site was closed in 1974. Several soil borings were taken from the disposal area in 1983. There are 30 groundwater monitoring wells located in the vicinity of the Silverton Road Waste Site, some of which have been monitored quarterly since 1982. A statistical analysis of groundwater monitoring data from this site was not conducted because of the lack of a background well. The major contaminants in the groundwater are trichloroethylene, tetrachloroethylene, trichloromethane, and lead. Closure options postulated for the Silverton Road Waste Site are waste removal and closure, no waste removal and closure, and no action. The predominant pathways for human exposure to chemical contaminants are through surface, subsurface, and atmospheric transport. Modeling calculations were performed to determine the risks to humans via these pathways for the three postulated closure options. Modeling calculations were also performed to determine ecological impacts. A cost estimate was prepared for each closure option. The environmental impact evaluations for the Silverton Road Waste Site indicate that the relative human health risks for all closure options are low.

44059 **(DPST—86-725) Quality assurance program for environmental assessment of Savannah River Plant waste sites: Environmental information document.** Looney, B.B.; King, C.M.; Stephenson, D.E. (Savannah River Lab., Aiken, SC (USA)). Mar 1987. Contract AC09-76SR00001. 86p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87013045.

Forty-eight locations were identified that received a variety of radioactive and nonradioactive constituents during the past 35 years including surface impoundments and shallow land burial facilities. Detailed environmental assessments of existing waste disposal areas, as well as new waste disposal techniques and disposition of tritiated water, were completed to air in an evaluation of the low level, mixed and hazardous waste management activities. These assessments result in estimation of risk, or residual risk, posed by each disposal area to various receptors as a function of waste management alternative. For example, at existing waste sites, the closure actions evaluated were waste removal and closure, no waste removal and closure, and no action; several pathways/receptors were considered, including groundwater to river, groundwater to well, atmospheric transport, occupational exposure, direct exposure, and contamination followed by ingestion of crops and meat. Modeling of chemical transport in a variety of media was an integral part of the assessment process. The quality of the models used and the application of these models were assured by an explicit quality assurance program.

44060 (SRO—819-17, pp 54-57) **Revegetation of Steel Creek delta and corridor.** Dunn, C.P.; Kelly, R.; Sharitz, R.R. Sep 1986. NTIS, PC A09/MF A01. File Number DE87012054.

In Ecological research at the Savannah River Ecology Laboratory: Annual report for the period ending July 31, 1986.

The wetland vegetation of Steel Creek was resurveyed in the fall of 1985 as part of a baseline study to assess potential environmental impacts associated with the re-start of L-Reactor. This report describes the vegetation of Steel Creek delta and corridor as of 1985 and documents vegetation changes in these areas. The earliest study of Steel Creek revegetation was completed in 1972; therefore, 13 years of vegetation data for portions of Steel Creek are available. This permits analysis of revegetation trends in a degraded forests wetland and speculation as to the possible return to a bald cypress-tupelo forest. 3 figures.

44061 (SRO—819-17, pp 58-62) **Response of wetland herbaceous communities to gradients of disturbance, light, and substrate.** Scott, M.L.; Dunn, C.P. Sep 1986. NTIS, PC A09/MF A01. File Number DE87012054.

In Ecological research at the Savannah River Ecology Laboratory: Annual report for the period ending July 31, 1986.

Multivariate analyses of wetland vegetation indicate that significant relationships between patterns of plant distribution and environmental factors occur. In forested wetlands, elevation (a measure of flooding frequency or duration) and soil characteristics are important correlates of plant community composition. Although herbaceous assemblages may respond independently of woody species, herbaceous species distributions are also affected by flooding and soil characteristics. Large-scale disturbances initiate successional change, and the intensity, frequency, and duration of such disturbances interact with site characteristics and species life histories to influence the patterning and diversity of plant communities. The distribution of plant species in wetlands resulting from these interactions has been little studied. The authors examined the distribution of herbaceous plant species relative to a thermal disturbance gradient and site characteristics in the 3020-ha, Savannah River wetland. The authors objectives were to (1) examine the pattern of occurrence of herbaceous plant species in areas with different disturbance regimes, using multivariate techniques, and (2) correlate observed patterns of species with site factors, including water depth, substrate type, and light levels. 2 figures, 1 table.

44062 (SRO—819-17, pp 73-77) **Sediment instability and woody seedling growth.** McLeod, K.W.; Sherrod, K.C. Jr. Sep 1986. NTIS, PC A09/MF A01. File Number DE87012054.

In Ecological research at the Savannah River Ecology Laboratory: Annual report for the period ending July 31, 1986.

Portions of the bald cypress-water tupelo swamp associated with the Savannah River are used as a cooling filter to mitigate the effects of thermal effluents. Interspecific differences in the tolerance of thermally-flooded conditions may explain observed patterns of mortality and revegetation in these areas. An impact of thermal effluents that has been largely overlooked is sediment instability. While responses to sediment instability, including both erosion and sedimentation, have been documented in field observations, few experimental studies have been undertaken on this topic. The ability to produce adventitious roots is probably an important characteristics of species successful in tolerating either sedimentation or erosion. Flooding can compound these problems. The authors objective was to document the growth and biomass responses to flooding, with and without sediment instability, and with and without subsequent flood recession, on seedlings of bald cypress, water tupelo, black willow, and buttonbush of the SRP swamp system. 1 figure, 1 table.

44063 (SRO—819-17, pp 83-88) **Management plan for establishment of littoral/wetland vegetation at L-Lake.** Wein, G.R. Sep 1986. NTIS, PC A09/MF A01. File Number DE87012054.

In Ecological research at the Savannah River Ecology Laboratory: Annual report for the period ending July 31, 1986.

The National Pollution Discharge Elimination System (NPDES) permit for the Savannah River Plant is site-wide, and applies to both construction and development of the L-Lake site. The current permit will be reviewed by the South Carolina Department of Health and Environment Control in July 1988; the first assessment of whether L-Lake supports a balanced biological community (BBC) will be made at that time. Since it is not reasonable to expect that a BBC will be developed and maintained in L-Lake by 1988, a demonstration of good faith toward establishment of a BBC is likely to be a major review criterion. To demonstrate good faith, The US Department of Energy (DOE) has made a commitment to construct and manage L-Lake so that a significant portion of the lake will be sufficiently cool to support a balanced biological community. In order to demonstrate good faith towards development of a BBC within L-Lake shoreline vegetation must be established. Similar establishment has occurred naturally over the past 28 years in Par Pond, a cooling lake located on the SRP. There are few reasons to doubt that portion of L-Lake would also support a balanced biological community in time. However, this is unlikely to occur

before evaluation of the site in 1988. Therefore, normal successional processes must be accelerated by the planting of native wetland species. 2 figures, 2 tables.

44064 (SRO—819-17, pp 126-129) **Effects of the 1985 drought on breeding and foraging ecology of wood storks in east-central Georgia.** Coulter, M.C. Sep 1986. NTIS, PC A09/MF A01. File Number DE87012054.

In Ecological research at the Savannah River Ecology Laboratory: Annual report for the period ending July 31, 1986.

Wood storks (Mycteria americana) are tactile-feeding wading birds. During the breeding season they depend on high densities of aquatic prey to obtain sufficient food for themselves and their young. The densities and population dynamics of their prey are greatly affected by the evaporation and rainfall regime. During dry periods evaporation may lower water levels and concentrate prey in small ponds. On the other hand, for optimal reproduction of the aquatic prey, a certain amount of rainfall is probably required. One may speculate that (1) during a dry year evaporation would concentrate the prey, and (2) during a wet year the prey would reproduce well and many foraging areas would be available. A severe drought occurred in 1985 in east-central Georgia. The authors studied the breeding biology and foraging ecology of wood storks at a rookery in Millen, Georgia, and compared their observations with those from 1984, a very wet year. Because the wood stork is an endangered species and storks from this rookery forage on the SRP, SREL has studied them since 1982. These studies are continuing in 1986. 1 figure, 1 table.

5106 Regulations

REFER ALSO TO CITATION(S) 43050, 43052, 43054, 44042, 44157, 44159, 44160, 44164, 44166, 44167, 44169, 44172, 44173, 44174, 44175

44065 **(PB—87-183786/XAB) Superfund Record of Decision (EPA region 3): Westline Site, McKean County, Pennsylvania, July 1986. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 4 Sep 1986. 48p. (EPA/ROD/R—03-86/024). NTIS, PC A03/MF A01.

The Westline Site is located in Westline, Lafayette Township, McKean County, Pennsylvania. Beginning in 1901, the Day Chemical Company converted lumber into charcoal, methanol, and acetic acid. Several tar-like deposits from the wood chemical-processing operations remain onsite. During the initial EPA site inspection in July of 1982, a sample of waste material was collected from tar seepage and analyzed for priority pollutants. Eighteen tentatively identified compounds were detected. In March 1986, a second wood-tar sample was collected to verify the presence or absence of polynuclear aromatic hydrocarbons (PAH). The primary contaminants of concern include phenol, 2,4-dimethylphenol, PAH compounds. The selected remedial action for this site includes: excavation of all wood-tar deposits and subsequent hauling of these wastes to a permitted offsite facility; backfilling of the excavated areas with clean soil and vegetation; incineration of excavated deposits with a high heating value and low ash content technique; ground water verification study; air monitoring.

44066 **(PB—87-183802/XAB) Superfund Record of Decision (EPA region 1): Industri-plex, Woburn, Massachusetts, September 1986. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 30 Sep 1986. 238p. (EPA/ROD/R—01-86/020). NTIS, PC A11/MF A01.

The Industri-plex site is a 245-acre industrial park located in Woburn, Massachusetts. Various manufacturing facilities operated on the site from 1853 to 1968. The presence of hazardous substances was detected in 1979. Portions of stockpiled wastes sloughed off, releasing hydrogen sulfide gases to the atmosphere and toxic metals and solids to the pond and wetlands. Large areas of the contaminated soils are exposed at the surface thereby allowing individuals and animals to come in direct contact with arsenic, chromium, and lead. Other contaminants of concern include benzene and toluene. The selected remedial alternatives for this site were recommended and are included in this report.

44067 **(PB—87-187738/XAB) Superfund Record of Decision (EPA Region 10): Toftdahl Drums, Brush Prairie, Clark County, Washington, September 1986. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 30 Sep 1986. 40p. (EPA/ROD/R—10-86/009). NTIS, PC A03/MF A01.

The Toftdahl Drum site, approximately 15 acres in area is located four miles east-southeast of Battleground, Washington, and contains three main areas where hazardous-substance hauling activities may have occurred: a drum cleaning area; an initial burial trench; and a final drum burial area. In the early 1970s, 100 to 200 drums containing unknown amounts of industrial waste, possibly from a plywood manufacturer, were delivered to the property. In 1982 the Washington Department of Ecology, notified of the possible presence of buried drums at the site, conducted an investigation. The Washington Department of Social and Health Services (DSHS) determined, based on the available sampling data from nearby residential wells, there was no immediate public health hazard in the drinking water. However, DSHS was concerned about the potential for future contamination from the high levels of heavy metals and synthetic organic compounds detected in the soil and drum samples. The remedial action selected for this site includes a no-further-action response and semi-annual ground water monitoring for five years, followed by ten years of annual monitoring pending continued funding by the Washington State Legislature.

44068 **(PB—87-187746/XAB) Superfund Record of Decision (EPA region 5): Seymour Recycling Corporation, Seymour, Indiana, September 1986. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 30 Sep 1986. 53p. (EPA/ROD/R—05-86/046). NTIS, PC A04/MF A01.

The Seymour Recycling Corporation (SRC) operated a processing center for waste chemicals. Toxic and hazardous wastes, including solvents, metal finishing wastes, and other materials, accumulated on the site in 55-gallon drums, bulk tanks, and other containers. Wastes leaked and spilled from the drums creating fire and odor problems. A Consent Decree resulted in the removal of the upper one foot of contaminated soil from about 75% of the site's surface. Contaminated soil remains, however, and extends throughout the shallow and deep aquifer. The primary contaminants of concern include: VOCs, organics, TCE, DCE, benzene, toluene, and heavy metals. Selected remedies have been proposed and are included.

44069 **(PB—87-187753/XAB) Superfund Record of Decision (EPA region 5): Spiegelberg, Green Oak Township, Livingston County, Michigan, September 1986. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 30 Sep 1986. 42p. (EPA/ROD/R—05-86/039). NTIS, PC A03/MF A01.

The Spiegelberg site was used for the disposal of domestic waste, with the main disposal area located in an abandoned sand and gravel pit in the northern third of the site. Paint sludge was dumped near the surface water portion of the gravel pit. Organic contaminants were detected in onsite and downgradient monitoring wells, indicating the migration of these contaminants from the site into the ground water. The primary contaminants of concern include: VOCs, organics, inorganics, base/neutral compounds, TCE, toluene, xylene, and metals. Selected remedial action for the site includes: excavation of 15,000 cubic yards of waste material which will be separated into liquid and solid sludges and paint residue with garbage intermixed; offsite incineration of approximately 5,000 cubic yards of the excavated waste material; and disposal of the remaining 10,000 cubic yards of waste into a RCRA landfill.

44070 **(PB—87-187761/XAB) Superfund Record of Decision (EPA region 8): Union Pacific Railroad Laramie Tie Treating Plant, Laramie, Wyoming, September 1986. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 26 Sep 1986. 61p. (EPA/ROD/R—08-86/010). NTIS, PC A04/MF A01.

The Union Pacific Railroad (UPRR) Tie Treating Plant is located southwest of Laramie, Wyoming. Wood-preserving agents used by UPRR or its contractor included: zinc chloride, a creosote

oil and asphalt-based petroleum/residuum oil mixture, PCP. Process wastes were disposed of in the Laramie Waste Collection ponds. Currently, 140 acres are contaminated. The contamination ranges from soil saturated with free oil to ground water containing dissolved contaminants. The selected interim source control remedy is a Contaminant Isolation System which includes: realignment of the Laramie River channel; a soil-bentonite slurry barrier wall constructed through the alluvium and bedrock around the contaminated areas; a reverse-gradient ground-water draining and pumping system; an activated-carbon water-treatment plant. The treated water will be discharged to the Laramie River under the authority of an NPDES permit issued and administered by the State of Wyoming; and ground water monitoring.

44071 **(PB—87-187779/XAB) Superfund Record of Decision (EPA region 4): SCRDI (South Carolina Recycling and Disposal, Inc.) Dixiana Site, Lexington County, South Carolina, September 1986. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 25 Sep 1986. 64p. (EPA/ROD/R—04-86/014). NTIS, PC A04/MF A01.

The SCRDI Dixiana site consists of a 2-acre lot and a warehouse in southeastern Lexington County, South Carolina. South Carolina Recycling and Disposal, Inc. (SCRDI) leased the site from G.M.T. in 1978 for drum storage of industrial wastes. Instances of poor-handling practices, leaky drums, and exposure to the weather allowed numerous discharges to the environment prior to drum removal. Potential sources of future contamination at the site are former drum storage areas and suspected spill areas. Contamination is presently moving offsite primarily via shallow ground water in response to the hydraulic gradients in various interconnected aquifers. The primary contaminants of concern include: VOCs, PAHs, PCBs, PCE, organics, pesticides, inorganics.

44072 **(PB—87-188371/XAB) Superfund Record of Decision (EPA region 3): Delaware City PVC (Polyvinylchloride Resin) Site, New Castle County, Delaware, September 1986. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 30 Sep 1986. 61p. (EPA/ROD/R—03-86/031). NTIS, PC A04/MF A01.

The Delaware City PVC site is located two miles northwest of Delaware City, New Castle County, Delaware. In 1966 Stauffer Chemical Company (SCC) of Westport, Connecticut, founded the Delaware City PVC Plant, which is used for the manufacturing of polyvinylchloride resin (PVC), polyvinyl acetate, and other polymers. An EPA-conducted inspection in May 1982 indicated serious contamination of the shallow ground water. Currently, ground water, surface water, and soils are contaminated with PVC, benzyl chloride monomer (VCM), TCE, and 1,2-dichloroethane (EDC).

44073 **(PB—87-188819/XAB) Superfund Record of Decision (EPA region 2): Combe Fill South Landfill, Morris County, New Jersey, September 1986. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 29 Sep 1986. 94p. (EPA/ROD/R—02-86/032). NTIS, PC A05/MF A01.

The Combe Fill South Landfill site is located in Morris County, New Jersey, 20 miles west of Morristown. The Combe Fill South Landfill was operated for 40 years as a municipal landfill, permitted to accept municipal and non-hazardous industrial wastes, sewage sludge, septic tank wastes, chemicals and waste oils. Testing indicated that the fill material consists mainly of highly decomposed rubbish, and that no hot spots or localized sources of hazardous substances exist. The primary contaminants of concern are VOCs, including TCE, PCE, toluene, benzene and methylene chloride, which have contaminated the shallow and deep aquifers that are the primary source of potable water for local residents.

44074 **(PB—87-188827/XAB) Superfund Record of Decision (EPA region 2): Price Landfill, Egg Harbor Township and Pleasantville, Atlantic County, New Jersey, September 1986 (second remedial action). Final report.** (Environmental Protection Agency, Washington, DC (USA)). 29 Sep 1986. 159p. (EPA/ROD/R—02-86/035). NTIS, PC A08/MF A01.

Price Landfill (also known as Price's Landfill Number One and Price's Pit) is a 26-acre site located in Egg Harbor Township and Pleasantville City, Atlantic County, NJ approximately six miles northwest of Atlantic City, NJ. The relatively flat site is located within the 11,600-acre watershed of Absecon Creek. Land use in the immediate area consists of residential properties, small-business properties, sand and gravel excavations, and undeveloped rural lots. In 1969, the facility became a commercial solid-waste landfill and in May 1971, began accepting a combination of both drummed and bulk liquid waste. Some liquid wastes were poured directly into the landfill from open tank truck spigots. Other waste was buried in 55-gallon drums, some of which were punctured or opened prior to disposal. An estimated 9.1 million gallons of chemical wastes were disposed of at the site. In 1980, residential wells in the area were found to be contaminated with volatile organic compounds, and the Atlantic County Health Department recommended that their use as a potable water supply be discontinued.

44075 **(PB—87-188843/XAB) Superfund Record of Decision (EPA region 4): Coleman Evans Wood Preserving Co., Jacksonville, Duval County, Florida, September 1986. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 25 Sep 1986. 78p. (EPA/ROD/R—04-86/019). NTIS, PC A05/MF A01.

The Coleman Evans Wood Preserving Company site is an active 11-acre wood-preserving facility located in the town of Whitehouse, Duval County, Florida. The site consists of two distinct areas: the western portion, which comprises the wood treating facility; and the eastern portion, which consists of a landfill area which has been used for the disposal of wood-chip and other wastes. Coleman Evans has produced wood products impregnated with PCP. Site investigations confirm soil and ground-water contamination, with PCP the primary contaminant of concern.

44076 **(PB—87-188868/XAB) Superfund Record of Decision (EPA region 5): Arcanum Iron and Metal, Twin Township, Darke County, Ohio, September 1986. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 26 Sep 1986. 43p. (EPA/ROD/R—05-86/036). NTIS, PC A03/MF A01.

The Arcanum Iron and Metal (AIM) site is a 4.5-acre site located in Twin Township, Darke County, Ohio, just southeast of the city of Arcanum and 25 miles northwest of Dayton. The AIM site operated as a lead-battery reprocessing facility from the early 1960s until 1982. During this operation, battery casings were split to extract lead cores for smelting. Reprocessing of the plastic and black-rubber battery casings generated lead oxide sludge and lead particulates which collected on the ground surface and surface ponds onsite. The primary contaminants of concern are antimony and arsenic leading the contaminants of secondary concern.

44077 **(PB—87-188876/XAB) Superfund Record of Decision (EPA region 4): Distler Brickyard, Hardin County, Kentucky, August 1986. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 19 Aug 1986. 88p. (EPA/ROD/R—04-86/015). NTIS, PC A05/MF A01.

The Distler Brickyard site is located near the Ohio River, approximately one-half mile south of West Point, Kentucky and about 17 miles southwest of Louisville. The site consists of the brick complex and associated buildings, and an open field covered with grasses and shrubs. In 1976, Mr. Donald Distler leased the brickyard property from Mr. Thomas Hoeppner, the owner, and began disposing wastes from Distler's Kentucky Liquid Recycling, Inc. firm. A partial removal of drums occurred, leading to later removal of 2,310 drums and visibly contaminated soil. Contents of the drums included liquids, sludges and solids found to be corrosive, volatile and flammable. The RI/FS, begun in April 1984, indicated soil and ground water contamination in the site area. Primary contaminants of concern are VOCs including TCE, DCE, benzene and toluene, naphthalene, bis (2-ethylhexyl) phthalate, and heavy metals.

44078 **(PB—87-188884/XAB) Superfund Record of Decision (EPA region 6): Geneva Industries, Houston, Texas, September 1986. Final report.** (Environmental Protection Agency, Washington, DC (USA)). Sep 1986. 85p. (EPA/ROD/R—06-86/012). NTIS, PC A05/MF A01.

The Geneva Industries site is a 13.5 acre tract located in Houston, TX, immediately adjacent to the corporate limits of the City of South Houston. Geneva Industries is an abandoned refinery which manufactured a variety of organic compounds and fuel oils from 1967 through 1978. Surface and subsurface onsite soils were contaminated as a result of operational spills, leaking drums, tanks, and lagoons, and landfill/land farming operations. The primary contaminants of concern include: VOCs, PAHs, TCE, PCBs, phenols, and fuel oils.

44079 **(PB—87-189056/XAB) Superfund Record of Decision (EPA region 10): United Chrome Products, Corvallis, Oregon, September 1986. Final report.** (Environmental Protection Agency, Washington, DC (USA)). Sep 1986. 40p. (EPA/ROD/R—10-86/008). NTIS, PC A03/MF A01.

The United Chrome Products (UCP) site is a former industrial hard chrome plating facility located in Corvallis, Oregon. UCP began electroplating operations in 1956. Between 1956 and 1975 an onsite dry well was used to dispose of floor drippings, washings, and product rinsate collected in a sump within the building. The liquids were reportedly neutralized with sodium hydroxide and/or soda ash prior to disposal. However, there is considerable chromium contamination in the soil beneath and around the building and in the upper and lower aquifers as a result of leaching from the dry well and plating tanks. Estimated capital cost for the selected remedial alternative is $1,580,000 and the annual O&M costs are approximately $261,000.

44080 **(PB—87-189064/XAB) Superfund Record of Decision (EPA region 3): Blosenski Landfill, West Caln Township, Chester County, Pennsylvania, September 1986. Final report.** (Environmental Protection Agency, Washington, DC (USA)). Sep 1986. 39p. (EPA/ROD/R—03-86/029). NTIS, PC A03/MF A01.

The Blosenski Landfill site is located on 13.6 acres in West Caln Township, Chester County, PA. The site is bordered by heavily wooded and agricultural areas. Approximately 467 residents live within one mile of the site. Beginning in the 1950s the site operated as a landfill accepting municipal and industrial wastes. Wastes were randomly dumped on the surface during the operating period, and included solvents, waste water treatment sludges, demolition and construction wastes, undercoating materials, and open and leaking drums. In 1982, EPA conducted a Site Inspection and found serious ground-water contamination. The primary contaminants of concern are VOCs including benzene, toluene, and TCE, and inorganics including lead, cadmium, chromium and mercury. The selected remedial action for the site will be conducted in four phases.

44081 **(PB—87-189072/XAB) Superfund Enforcement Decision Document (EPA region 1): Winthrop Landfill, Winthrop, Maine, November 1985. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 22 Nov 1985. 54p. (EPA/ROD/R—01-85/015). NTIS, PC A04/MF A01.

The Winthrop Landfill consists of two contiguous parcels of 11 acres, with approximately 9.5 acres located along the western shore of Annabessacook Lake in the Town of Winthrop, Maine. The site was initially used in the 1920s as a sand and gravel pit. In the 1930s, parts of the site became the Winthrop Town Dump, accepting mixed municipal, commercial, and industrial wastes. The site received hazardous substances between the early 1950s and mid-1970s. It is estimated that more than 3 million gallons of chemical wastes, mostly complex organic compounds including resins, plasticizers, solvents, and other process chemicals, were disposed at the site. The selected remedial actions for this site are cited.

44082 **(PB—87-189361/XAB) Superfund Record of Decision (EPA region 5): Metamora Landfill, Metamora, Lapeer County, Michigan, September 1986. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 10 Sep 1986. 46p. (EPA/ROD/R—05-86/040). NTIS, PC A03/MF A01.

The Metamora Landfill site is located in Metamora Township, Lapeer County, MI. The 80-acre landfill was previously used for gravel mining and in 1966 as a privately owned, unregulated dump. The site accepted both municipal and industrial waste until its closure in 1980. The Michigan Department of Natural Resources (MDNR) sampled seven of these drums and identified the presence of VOCs and other organics. Remedial actions for ground water, which poses a public health threat, and soil and which have not been addressed due to insufficient data detailed the extent of contamination. The primary contaminants of concern include: VOCs, PCE, TCE, and heavy metals.

44083 **(PB—87-189379/XAB) Superfund Record of Decision (EPA region 5): Lasalle Electrical Utilities Site, Lasalle, Illinois, August 1986. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 29 Aug 1986. 42p. (EPA/ROD/R—05-86/041). NTIS, PC A03/MF A01.

The LaSalle Electrical Utilities (LEU) site is located in west-central LaSalle County in the city of LaSalle in north-central Illinois. Between the late 1940s and 1978, PCBs were utilized in the production of capacitors. Following the regulation of PCBs, the disposal of PCBs at all regulated facilities was mandated. Beginning in September 1975, numerous government agencies conducted various inspections and issued numerous complaints and orders to the LEU company as a result of its manufacturing and handling practices. The primary contaminant of concern is PCB.

44084 **(PB—87-189387/XAB) Superfund Record of Decision (EPA region 5): Reilly Tar and Chemical Corporation, St. Louis Park, Minnesota, May 1986 (second remedial action). Final report.** (Environmental Protection Agency, Washington, DC (USA)). 30 May 1986. 41p. (EPA/ROD/R—05-86/038). NTIS, PC A03/MF A01.

See also PB—85-213965.

The Reilly Tar and Chemical Corporation (RTCC) site occupies 80 acres in St. Louis Park, Minnesota. The Republic Creosote Works, which operated the site between 1917 and 1972, fractionalized coal tar into various oils and produced creosote. The wastes resulting from the process polluted the land surface of the site and the underlying aquifers. The primary contaminants of concern include: PAHs and phenols. The Remedial Action Plan (RAP) attached to the Consent Decree prescribes the remedial actions.

44085 **(PB—87-189395/XAB) Superfund Enforcement Decision Document (EPA region 4): Lees Lane Landfill, Louisville, Kentucky, September 1986. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 25 Sep 1986. 51p. (EPA/ROD/R—04-86/017). NTIS, PC A04/MF A01.

The Lees Lane Landfill (LLL) site is located adjacent to the Ohio River in Jefferson County, Kentucky. Land use at the site has included a sand and gravel quarry, a junkyard, and a landfill. An investigation detected explosive levels of methane gas and seven families were evacuated from homes near the site. Surface water, soil, and ground water are contaminated with benzene, heavy metals including lead, arsenic, and chromium, and inorganics.

44086 **(PB—87-189411/XAB) Superfund Record of Decision (EPA region 2): Sharkey Landfill, Morris County, New Jersey, September 1986. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 29 Sep 1986. 69p. (EPA/ROD/R—02-86/030). NTIS, PC A04/MF A01.

The Sharkey Landfill site comprises approximately 90 acres in the Parsippany - Troy Hills and East Hanover Townships, Morris County, NJ. In 1945 the site began accepting municipal solid waste from NJ counties. Between 1962 and 1969, Ciba-Geigy Co. allegedly disposed of 753,000 lbs. of hazardous and/or toxic materials. From April 1972 to May 1972, 25,700 tons of non-chemical wastes and 1160 tons of liquid and/or chemical wastes described as cesspool-type, and sludge from the adjacent Parsippany-Troy Hills Sewage Treatment Plant (PTHSTP) were also deposited at the site. Between 1979 and 1981 refuse was removed from the South Fill portion of the site and re-disposed in the North Fill area for a PTHSTP expansion. Currently, landfill contaminants have migrated and continue to migrate into the shallow aquifer beneath the site and the adjacent surface-water bodies. Although available data do not suggest that significant quantities of hazardous substances are being released at the present time, there exists the potential for future releases of contaminants at levels which could pose a serious threat to public health and the environment. The primary contami-

nants of concern include: VOCs, TCE, organics, inorganics, and heavy metals.

44087 **(PB—87-189742/XAB) Superfund Record of Decision (EPA region 4): Hipps Road Landfill, Jacksonville, Duval County, Florida, September 1986. Final report.** (Environmental Protection Agency, Washington, DC (USA)). Sep 1986. 195p. (EPA/ROD/R—04-86/010). NTIS, PC A09/MF A01.

Hipps Road Landfill is located in Jacksonville Heights, Duval County, Florida. In February 1983 area residents began to complain of a foul odor and taste in the drinking water. Well sampling identified the presence of Volatile Organic Compounds (VOC) in the drinking water. During re-sampling studies, larger suites of VOCs and metals were discovered. Between June and October 1983, the city installed waterlines supplying the site residents with city water. By January 1985 ground water was no longer a source for drinking water in the area. The primary contaminants of concern include: VOCs, TCE, metals, xylene, toluene, benzene. The selected remedial action includes ground-water recovery and treatment at the POTW; Subtitle D landfill closure; and institutional controls. The estimated cost for this remedy is $3.9-4.4 million. Capital and O&M costs were not specified separately, however, EPA will fund O&M activities for one year after completion of the remedial action. O&M will continue for 20 years using funds provided by the State of Florida.

44088 **(PB—87-189759/XAB) Superfund Record of Decision (EPA region 7): Ellisville Area Site - Bliss and Contiguous Properties, St. Louis County, Missouri, September 1986. (second remedial action). Final report.** (Environmental Protection Agency, Washington, DC (USA)). 29 Sep 1986. 86p. (EPA/ROD/R—07-86/006). NTIS, PC A05/MF A01.

The Ellisville Site Area, located in West St. Louis County, Missouri, is composed of three non-contiguous properties: the Rosalie property; the Callahan property; and the Bliss property. During the 1960s and 1970s, Russell Bliss owned and operated the Bliss Waste Oil Company, a business engaged in the transportation and disposal of waste oil products, industrial wastes and chemical wastes. In September 1980 the Missouri Department of Natural Resources and the U.S. EPA conducted an onsite investigation. Concluding reports indicated pits had been dug and used for industrial waste disposal; drums of waste had been buried on site; and liquid wastes had been applied on the ground. The types of waste were reported to include solvents, oils, pesticides, and can-coating materials. Dioxin is currently the only contaminant of threat. Approximately 20,000 cubic yards of soil, and an unknown volume of dust are contaminated with 2,3,7,8-TCDD (TCDD or dioxin).

44089 **(PB—87-189767/XAB) Superfund Record of Decision (EPA region 3): Army Creek Landfill Site, New Castle County, Delaware, September 1986. Final report.** (Environmental Protection Agency, Washington, DC (USA)). Sep 1986. 58p. (EPA/ROD/R—03-86/032). NTIS, PC A04/MF A01.

The Army Creek Landfill (ACL), formerly known as the Llangollen Landfill, is located approximately two miles southwest of New Castle, Delaware, and is adjacent to the Delaware Sand and Gravel Landfill Superfund site. The County operated this 44-acre landfill, which accepted municipal wastes, from 1960 until its closure in 1968 when it was filled to capacity. In late 1971, water in a residential well downgradient of the site developed quality problems. Results from a subsequent investigation showed that leachate, most likely originating from the Army Creek and Delaware Sand and Gravel Landfills, was contaminating local aquifers. This lead to the installation of a ground water recovery system designed to maintain a ground water divide between the landfills and the Artesian Water Company Wellfield located downgradient of the landfills. The primary contaminants of concern include: VOCs, inorganics, heavy metals, benzene, and chromium.

44090 **(PB—87-189775/XAB) Superfund Record of Decision (EPA region 3): Millcreek Site, Erie County, Pennsylvania, May 1986. Final report.** (Environmental Protection Agency, Washington, DC (USA)). May 1986. 43p. (EPA/ROD/R—03-86/023). NTIS, PC A03/MF A01.

The Millcreek site located in Millcreek Township, Erie County, Pennsylvania, was filled with foundry sand and industrial and municipal waste such as halogenated volatile solvents. This disposal resulted in significant ground-water contamination both on- and offsite. The major classes of compounds detected included: polychlorinated biphenyls (PCBs), polynuclear aromatic hydrocarbons (PAHs), phthalates, volatile organics, phenols and metals such as lead and copper. The selected remedial action for this site includes: excavation and consolidation of contaminated soil and sediments under a RCRA cap to meet proposed criteria; site grading; placing a soil cover over remaining low level contaminated soils not exceeding the proposed criteria; construction of surface water management basins and ditches; revegetation of soil cover and cap; installation of additional monitoring wells; construction of a flood retention basin on property owned by Millcreek Township; pumping and treating of contaminated ground water; additional sampling and well installation and ground-water monitoring.

44091 **(PB—87-189890/XAB) Superfund Record of Decision (EPA region 5): Forest Waste Disposal Site, Genesee County, Michigan, June 1986. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 30 Jun 1986. 66p. (EPA/ROD/R—05-86/034). NTIS, PC A04/MF A01.

The Forest Waste Disposal Site has a landfill with a surface area of approximately 15 acres, and nine surface impoundments with a collective surface area of approximately one acre. From 1973 to 1978, the site received general refuse, industrial and liquid waste, PBBs, and PCBs. Drummed wastes from various sources were disposed of in the landfill area, and waste oils, metallic sludges, paint and resin wastes, and spent sulfuric acid were disposed in the onsite lagoons. Currently, onsite soils and sediments are contaminated with priority pollutant compounds and various organic and heavy metal compounds. The selected source control remedial alternative includes excavation, treatment, and disposal of contaminated sludges, sediments and soils in an offsite RCRA-permitted landfill, and removal, treatment, and disposal of 110,000 gallons of aqueous lagoon wastes at an RCRA treatment facility.

44092 **(PB—87-189908/XAB) Superfund Enforcement Decision Document (EPA region 2): Smuggler Mountain, Pitkin County, Colorado, September 1986. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 26 Sep 1986. 53p. (EPA/ROD/R—02-86/037). NTIS, PC A04/MF A01.

The Smuggler Mountain site is located immediately northeast of the City of Aspen in Pitkin County, Colorado. It comprises 110 acres of waste rock, tailings, and slag containing high levels of lead and cadmium. The mining wastes which characterize the site are the result of years of extensive mining, milling, and smelting operations. As a result, wastes are highly dispersed, and little is known about their disposition. Soil is the primary contaminated medium; however, contaminants have been detected in some ground and surface waters. The selected remedial action for the site is broken into distinct operable units. Operable Unit 1 - excavation and permanent onsite disposal of soils with lead above 5,000 ppm, including a RCRA multi-layer cap; soil capping of all areas with lead between 1,000 and 5,000 ppm lead; five-year ground water monitoring; and provision of a permanent alternate water supply for 5-7 residences. Operable Unit 2 - supplemental RI/FS, with possible ground water remediation and mine reclamation activities.

44093 **(PB—87-189957/XAB) Superfund Record of Decision (EPA Region 2): Metaltec/Aerosystems, Franklin Borough, New Jersey, June 1986. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 30 Jun 1986. 87p. (EPA/ROD/R—02-86/025). NTIS, PC A05/MF A01.

The Metaltec/Aerosysems site is located in Franklin Borough, Sussex County, New Jersey. The site contains several sources of hazardous substances including trichloroethylene, trans-1, 2-dichloroethene, vinyl chloride, and copper. The remedial action selected for this site includes: excavation and treatment via heat addition of organic contaminated soils and offsite disposal at an approved landfill; excavation and offsite disposal of approximately 4000 cubic yards of contaminated soils; preparation of a supplement RI and FS to identify the extent of ground water contamination and develop

and evaluate appropriate remedial alternatives; and provision of an alternate water supply for affected areas.

44094 **(PB—87-189965/XAB) Superfund Record of Decision (EPA Region 3): Tybouts Corner Landfill, New Castle County, Delaware, March 1986. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 6 Mar 1986. 77p. (EPA/ROD/R—03-86/019). NTIS, PC A05/MF A01.

The Tybouts Corner Landfill, consisting of two fill areas, was originally a sand and gravel pit and was used for the disposal of municipal and domestic refuse. Industrial wastes disposed there included: trichloroethylene, vinyl chloride, 1.2-dichloroethane, benzene, and various other organic and inorganic chemicals. The main threat posed by Tybouts Corner Landfill is that the hazardous substances disposed of in the landfill are contaminating the local and regional aquifers which are a main source of water for the region. Selected remedial actions for this site are proposed and are included in the report.

44095 **(PB—87-190013/XAB) Superfund Record of Decision: (EPA Region 3): Limestone Road Site, Cumberland, Maryland, September 1986. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 30 Sep 1986. 78p. (EPA/ROD/R—03-86/026). NTIS, PC A05/MF A01.

The Limestone Road site is located 2.5 miles east southeast of Cumberland, Allegheny County, Maryland, on the western flank of Irons Mountain and includes large areas of landfilled and dumped commercial, residential, and demolition refuse. A variety of waste has reportedly been dumped into a ravine on the property such as chromium, lead, and cadmium. In addition, an alleged 11 tons of hazardous waste have been reportedly disposed of as an extension of filling and grading operations. The primary contaminants of concern include: VOCs, base-neutral compounds, TCE, PCE, and heavy metals. Remedial action is proposed and included in the report.

44096 **(PB—87-190021/XAB) Superfund Enforcement Decision Document (EPA Region 2): Hyde Park Landfill, Town of Niagara, New York, November 1985. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 26 Nov 1985. 82p. (EPA/ROD/R—02-86/038). NTIS, PC A05/MF A01.

Occidental Chemical Corporation (OCC) disposed of approximately 80,000 tons of chemical wastes at the Hyde Park landfill and 0.6 to 1.6 tons of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) contaminated material. Between 1975 and 1979, OCC implemented a number of remedial actions. These actions included capping the site, and installing a shallow tile drain and a groundwater monitoring program. Soil and ground water are contaminated with VOCs, organics, toluene, phenol, PCBs, and dioxin. Selected remedies are proposed and described in the report.

44097 **(PB—87-190039/XAB) Superfund Record of Decision (EPA Region 6): United Creosoting Company, Hilbig Road, Conroe, Texas, September 1986. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 30 Sep 1986. 71p. (EPA/ROD/R—06-86/014). NTIS, PC A04/MF A01.

The United Creosoting site, Montgomery County, Texas, operated from 1946 to 1972, treating wood with creosote and pentachlorophenol (PCP). During the summer of 1980, Montgomery County obtained soils from the United Creosoting site to be used in improving local roads in a nearby subdivision. Samples indicated that soils were contaminated with PCP, chlorinated dioxins (no tetrachlorinated dioxins), and dibenzofurans. EPA ordered Clark Distributing to undertake an Immediate Response Action within the area of the former waste ponds. Remedial actions were recommended and are included in the report.

44098 **(PB—87-190120/XAB) Superfund Record of Decision (EPA Region 5): Burrows Sanitation Site, Hartford, Van Buren County, Michigan, September 1986. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 30 Sep 1986. 55p. (EPA/ROD/R—05-86/037). NTIS, PC A04/MF A01.

The Burrows Sanitation site is a ten-acre site located on 54th Avenue in Hartford Township, Van Buren County, Michigan. The site was used for dewatering and disposing of metal hydroxide sludges, waste coolants, and soluble oils. Sampling of these areas indicates that the former source materials were removed so they no longer present a potential health threat via direct contact or ingestion. Wastes similar to the excavated wastes remain in the newly identified Spill Area No. 2. Principal contaminants include chromium, copper, lead, nickel, zinc, and cyanide. Test results also indicate that the surface water and sediments in the Northwest Wetland and drainage canal have been impacted by the site. In addition, onsite monitoring wells indicate a limited chemical plume or plumes related to site activities.

44099 **(PB—87-191888/XAB) Superfund Record of Decision (EPA Region 3): Middletown Road Site, Annapolis, Maryland, March 1986. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 17 Mar 1986. 39p. (EPA/ROD/R—03-86/021). NTIS, PC A03/MF A01.

The Middletown Road Site is a privately owned waste dump, consisting of approximately 2.3 acres, located off Maryland Route 50 near Annapolis, Anne Arundel County, Maryland. The site operated as a dump, primarily for rubble and construction debris, for several decades without proper State permits. In 1981, it was discovered that approximately 40 drums and four dumpster loads of suspected hazardous substances were on the site. On June 24, 1983, $384,000 in CERCLA money was allocated for immediate removal measures to excavate and remove hazardous substances and contaminated soil. A remedial investigation was conducted to determine whether any remedial action would be needed before deleting the site from EPA's National Priorities List. Based on the findings of the RI, no risk to receptors via direct contact, inhalation, or ingestion was found.

44100 **(PB—87-194643/XAB) Use of the water-balance method for predicting leachate generation from solid-waste-disposal sites.** Fenn, D.G.; Hanley, K.J.; DeGeare, T.V. (Environmental Protection Agency, Washington, DC (USA). Office of Solid Waste). 1975. 44p. (EPA/SW—168). NTIS, PC A03/MF A01.

Recognizing the importance of percolation in the environmental assessment of a potential leachate problem at a land-disposal site, the paper analyzes the factors effecting percolation and its relationship to leachate generation and discusses a methodology to estimate leachate generation. The methodology is based on the water-balance method commonly used in the soil and water conservation fields.

44101 **(PB—87-201034/XAB) Remedial action at waste-disposal sites: handbook (revised).** (Science Applications International Corp., McLean, VA (USA)). Oct 1985. 681p. NTIS, PC A99/MF E04.

See also report dated Jun 85, PB—85-238616.

The handbook is intended for use as a basic reference tool on remedial action. It will assist governmental and industrial officials and technical persons in understanding remedial technologies; selecting potentially applicable technologies for a given waste site, and planning for remedial action.

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REFER ALSO TO CITATION(S) 43051, 43317, 44220

44102 **(DOE/ER—0321) Remote sensing-arid lands workshop, Page, Arizona, June 10-12, 1986: Workshop summary report.** Hawkins, R.H.; Wobber, F.J.; Springer, E.P. (Utah State Univ., Logan (USA); USDOE Office of Energy Research, Washington, DC. Ecological Research Div.; Los Alamos National Lab., NM (USA)). May 1987. 32p. (CONF-860618—Summs.). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012368.

From REmote FLuvial EXperiments (REFLEX) in arid lands - predictive modeling seminar; Page, AZ, USA (9 Jun 1986).

This report describes research sponsored by the US Department of Energy (DOE) Office of Energy Research to evaluate advanced remote sensing technologies for environmental research. The program denoted as REFLEX (REmote FLuvial EXperiments) stresses new applications of remote sensing systems and advanced digital analysis to the solution of environmental problems from energy development. REFLEX experiments are being conducted at sites within the continental United States and Alaska. The experiments described here are being done on arid and semiarid sites in the western United States. Currently, two REFLEX experiments are being conducted in arid/semiarid ecosystems. At the Pacific Northwest Laboratory (PNL) in Richland, Washington, the REFLEX experiment will test hypotheses on the prediction of evapotranspiration (ET) over arid landscapes. The heterogeneity of arid and semiarid landscapes makes estimation of ET over an area quite difficult, and remote sensing, both aerial and ground based, offers tremendous potential in solving this sampling problem. The second REFLEX experiment in arid/semiarid ecosystems is being conducted on surface hydrology and soil erosion in arid watersheds. Two study sites, the Plutonium Valley Watershed at the Nevada Test Site and Walnut Gulch Experimental Watershed at Tombstone, Arizona, have been selected for the experiment. Remote sensing will be used to initialize and parameterize hydrologic models that can predict watershed responses to change on two spatial and temporal scales.

44103 **(PB—87-103230/XAB) Gulf of Alaska: Physical Environment and Biological Resources.** Hood, D.W.; Zimmerman, S.T. (National Ocean Service, Anchorage, AK (USA). Ocean Assessments Div.). Jun 1987. 629p. NTIS, PC A99/MF A01.

The Gulf of Alaska: Physical Environment and Biological Resources' is a comprehensive treatise of over 600 pages. The multi-author document contains twenty chapters on a broad spectrum of marine disciplines that consolidate the authors knowledge of the region into a single document. It is heavily referenced and, in addition, includes a glossary and extensive index. The book is intended for a broad audience: students, researchers, resource managers and the public.

44104 **(PB—87-195137/XAB) Outer Continental Shelf environmental assessment program. Final reports of principal investigators. Volume 53.** (National Ocean Service, Anchorage, AK (USA). Ocean Assessments Div.). Dec 1986. 859p. NTIS, PC A99/MF E04.

See also PB—86-210978, and PB—87-195145 through PB—87-195178.

Contents include: Baffin Island experimental oil spill and dispersant studies. Hydrocarbon bioaccumulation and histopathological and biochemical responses in marine bivalve molluscs; Feeding ecology of juvenile king and Tanner crab in the southeastern Bering Sea; Distribution of larval and juvenile red king crabs (Paralithodes camtschatica) in Bristol Bay; Distribution and abundance of decapod crustacean larvae in the southeastern Bering Sea with emphasis on commercial species.

44105 **(PB—87-195178/XAB) Distribution and abundance of decapod crustacean larvae in the southeastern Bering Sea with emphasis on commercial species. Final report.** Armstrong, D.A.; Incze, L.S.; Wencker, D.L.; Armstrong, J.L. (National Ocean Service, Anchorage, AK (USA). Ocean Assessments Div.). 1981. 398p. NTIS, PC A99/MF E04.

Contents include: Distribution and abundance of king crab larvae, Paralithodes camtschatica and P. platypus in the southeast Bering Sea; Distribution and abundance of the larvae of tanner crabs in the southeastern Bering Sea; Distribution and abundance of other brachyuran larvae in the southeastern Bering Sea with emphasis on Erimacrus isenbeckii; Distribution and abundance of shrimp larvae in the southeastern Bering Sea with emphasis on pandalid species; Distribution and abundance of hermit crabs (Paguridae) in the southeasternBering Sea; Possible oil impacts on decapod larbae in the southeastern Bering Sea with emphesis on the St. George Basin.

44106 **(PB—87-195186/XAB) Outer Continental Shelf environmental assessment program. Final reports of principal investigators. Volume 54.** (National Ocean Service, Anchorage, AK (USA). Ocean Assessments Div.). Feb 1987. 674p. NTIS, PC A99/MF E04.

See also PB—87-195137 and PB—87-195194 through PB—87-195236.

Contents include: Distribution, abundance, community structure, and trophic relationships of the benthos of the northeastern Gulf of Alaska from Yakutat Bay to Cross Sound; Habitat requirements and expected distribution of Alaska coral; A survey for spawning forage fish on the east side of the Kodiak Archipelago by air and boat during spring and summer 1979; Seasonal composition and abundance of juvenile and adult marine finfish and crab species in the nearshore zone of Kodiak Island's eastside during April 1978 through March 1979; Ecology and behavior of southern hemisphere shearwaters (Genus Puffinus) when over the outer continental shelf of the Gulf of Alaska and Bering Sea during the Northern summer (1975-1976).

44107 **(PB—87-195194/XAB) Distribution, abundance, community structure, and trophic relationships of the benthos of the northeastern Gulf of Alaska from Yakutat Bay to Cross Sound. Final report.** Feder, H.M.; Jewett, S.C.; McGee, S.G.; Matheke, G.E.M. (National Ocean Service, Anchorage, AK (USA). Ocean Assessments Div.). Mar 1981. 202p. NTIS, PC A99/MF E04.

The species objectives of the investigation were to present: (1) a quantitative inventory of dominant epifaunal invertebrates; (2) a description of spatial distribution patterns of selected epifaunal invertebrates; (3) assess spatial distribution and relative abundance of selected infaunal invertebrate species; and (4) observations of biological interrelationships, emphasizing trophic interactions, between selected segments of the benthic biota. During 6-25 November, 1979, trawls were made at 42 offshore stations, 33 of which were within an identified high-priority area. Operations associated with oil exploration, production, and transportation in the northeast Gulf of Alaska present a broad spectrum of potential dangers to the marine environment. Adverse effects on the marine environment of this area cannot be assessed nor predicted, unless background data are recorded prior to industrial development.

44108 **(PB—87-195202/XAB) Habitat requirements and expected distribution of Alaska coral. Final report.** Cimberg, R.L.; Gerrodette, T.; Muzik, K. (National Ocean Service, Anchorage, AK (USA). Ocean Assessments Div.). Oct 1981. 98p. NTIS, PC A99/MF E04.

The objectives of the study are to provide the Alaskan OCS office of the Bureau of Land Management with: (1) a compilation and synthesis of information from the literature and other sources regarding the distribution, abundance, habitat requirements, and probable locations of corals along the Alaskan OCS waters; (2) a discussion of the potential effects of oil and gas exploration and development on corals; and (3) recommendations for further studies of corals and the effects of oil and gas exploration and development on these organisms.

44109 (PB—87-195210/XAB) Survey for spawning forage fish on the east side of the Kodiak archipelago by air and boat during spring and summer 1979. Final report. Blackburn, J.E.; Jackson, P.B.; Warner, I.M.; Dick, M.H. (National Ocean Service, Anchorage, AK (USA). Ocean Assessments Div.). Oct 1981. 66p. NTIS, PC A99/MF E04.

The project was designed to study aspects of forage fish biology along the eastside of the Kodiak Archipelago from Afognak Island to Sitkinak Island. The results of the project contribute to the data base necessary for an environmental impact statement required by law prior to Outer Continental Shelf lease sales. The objectives are to: Determine the temporal and spatial distribution of spawning by nearshore pelagic forage fishes. Determine age, weight and length relationships of these fish species; Identify spawning substrate commonly used by herring, capelin and other species encountered; and Determine density of herring and capelin spawn on substrate.

44110 (PB—87-195228/XAB) Seasonal composition and abundance of juvenile and adult marine finfish and crab species in the nearshore zone of Kodiak Island's eastside during April 1978 through March 1979. Final report. Blackburn, J.E.; Jackson, P.B. (National Ocean Service, Anchorage, AK (USA). Ocean Assessments Div.). Apr 1982. 192p. NTIS, PC A99/MF E04.

The study was one portion of a multiple-part study of the marine ecosystem on the east side of the Kodiak Archipelago, which was conducted in preparation for exploratory drilling for oil and gas on the continental shelf. The study was to determine the seasonal composition, relative abundance, movements, and habitat use of principal finfish (and commercial crabs) in the nearshore zone. Associated studies used fish and crabs captured in the study for food habits studies. Oil exploration in the Kodiak lease area constitutes a potential for environmental degradation, and it is a legal requirement of the Bureau of Land Management (BLM) to consider this potential as a part of the cost of leasing.

44111 (PB—87-195236/XAB) Ecology and behavior of Southern Hemisphere shearwaters (genus Puffinus) when over the Outer Continental Shelf of the Gulf of Alaska and Bering Sea during the northern summer (1975-1976). Final report. Guzman, J.R.; Myres, M.T. (National Ocean Service, Anchorage, AK (USA). Ocean Assessments Div.). Oct 1982. 109p. NTIS, PC A99/MF E04.

Several millions of Sooty shearwaters (Puffinus griseus) and Short-tailed shearwaters (P. tenuirostris) visit Alaskan coastal waters (OCS) during the northern summer months. The objectives were to learn something about the activities of these Southern Hemisphere seabirds and to delineate: (1) their distributions; (2) their regional movements and responses to environmental influences; (3) the ecological requirements of these shearwaters, and (4) whether shearwaters would be at serious risk from oil drilling and production.

44112 (PB—87-196432/XAB) Offshore environmental studies program: environmental studies index. Atlantic Outer Continental Shelf, 1986. Summary report. (Minerals Management Service, Vienna, VA (USA). Atlantic OCS Region). 1986. 297p. (OCS/MMS—86/0020). NTIS, PC A13/MF A01.

See also PB—87-195954.

The Environmental Studies Program of the U.S. Department of the Interior was developed as a response to statutory imperatives. The Environmental Studies Program began in 1973 under the Bureau of Land Management. In May 1982, this program along with all leasing and resource management functions of the Outercontinental shelf (OCS) were consolidated and placed within the Minerals Management service (MMS). OCS functions within the MMS are divided into four regions: Alaska, Atlantic, Gulf of Mexico, and Pacific. Past and ongoing contracts have produced numerous technical reports, maps, data banks, and other products for use in the planning and management of OCS activities. The document is a summary of environmental studies that have been produced for the Department of the Interior in the Atlantic Region. Studies are presented by individual contract for the period 1973-1985.

44113 (PB—87-198719/XAB) North Atlantic slope and canyon study. Volume 1. Executive summary. Butman, B. (Geological Survey, Woods Hole, MA (USA)). Dec 1986. 67p. NTIS, PC A04/MF A01.

See also Volume 2, PB—87-198727.

A field program to investigate the currents and sediment transport along the outershelf and upper slope along the southern flank of Georges Bank was conducted between 1980 and 1984. A major part of the field experiment was conducted in Lydonia Canyon, a large submarine canyon which cuts northward about 20 km into the continental shelf from the shelfbreak. A smaller experiment was conducted in Oceanographer Canyon to compare the currents in these two major canyons. The long-term current observations made in Lydonia and Oceanographer Canyons show that the current regime in these topographic features differs from the adjacent slope, and between canyons. Sediments near the head (depths shallower than about 600 m) in both Lydonia and Oceanographer are frequently resuspended. This frequent resuspension may allow the sediments to strip pollutants from the water column. Currents in Oceanographer Canyon are stronger and the sediments coarser than in Lydonia at comparable depths.

44114 (PB—87-198727/XAB) North Atlantic slope and canyon study. Volume 2. Final report. Butman, B. (Geological Survey, Woods Hole, MA (USA)). Dec 1986. 569p. NTIS, PC A24/MF A01.

See also Volume 1, PB—87-198719.

A field program to investigate the currents and sediment transport along the outershelf and upper slope along the southern flank of Georges Bank was conducted between 1980 and 1984. A major part of the field experiment was conducted in Lydonia Canyon, a large submarine canyon which cuts northward about 20 km into the continental shelf from the shelfbreak. A smaller experiment was conducted in Oceanographer Canyon to compare the currents in these two major canyons. Long-term current observations were made at 20 locations in or adjacent to Lydonia Canyon, and at 9 stations on the continental slope. Detailed semi-synoptic hydrographic observations were made on 9 cruises. The currents associated with Gulf Stream warm core rings (WCR's) strongly affect the flow along the outer shelf and upper slope; eastward currents in excess of 75cm/s were associated with WCR's.

44115 (PB—87-200051/XAB) Analysis of trace metals in bottom sediments in support of deepwater biological processes studies on the US South Atlantic continental slope and rise. Final report, 1 May 1985-31 March 1987. Bothner, M.H.; Campbell, E.Y.; DiLisio, G.P.; Parmenter, C.M.; Rendigs, R.R. (Geological Survey, Woods Hole, MA (USA)). 31 Mar 1987. 49p. NTIS, PC A03/MF A01.

See also report dated Jan 86, PB—86-199312.

The study is part of a multidisciplinary program conducted along the entire continental slope and rise off the Atlantic states to characterize the biology, chemistry, and geology of the sea floor prior to exploratory drilling for petroleum. The distribution of sediment types and associated trace metals from natural sources will be used to help predict the fate of sediment reactive contaminants introduced to the water column by future development activities. Sediment samples collected on three cruises to the continental slope and rise off the South Atlantic states were analyzed for 12 metals (Al, Ba, Cd, Cr, Cu, Fe, Hg, Mn, Ni, Pb, V, and Zn). The metal concentrations are lower than those reported for world-average shales, indicating an absence of major contamination. At some locations, Pb is enriched in the surface sediments by about a factor of 2 higher than deeper sections of sediment cores. The maximum concentration of Pb is only 17 ppm. This enrichment is probably related to onshore burning of gasoline containing lead additives. The potential biological effects of this enrichment cannot yet be evaluated. There is a positive correlation between the concentration of metals and the concentration of silt and clay. Lead inventories at stations at the northern limit of the study area are 5-10 times higher than predicted from the estimated atmospheric flux over the last century. Biological, chemical, and physical processes which enhance metal scavanging from seawater must be relatively intense to account for the high inventories.

5202 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 42970, 42993, 42995, 42997, 42999, 43406, 43485, 43655, 43999, 44001, 44009, 44037, 44040, 44041, 44043, 44045, 44049, 44145, 44150, 44165, 44208, 44210

44116 **(PB—87-194585/XAB) Wastes in marine environments.** (Office of Technology Assessment (U.S. Congress), Washington, DC). Apr 1987. 313p. (OTA—0-334). NTIS, PC A14/MF A01.

Library of Congress catalog No. 87-619813.

Contents include: Findings and options; Understanding marine disposal; The broader context; Waste-disposal activities and pollutant inputs; Marine environments and processes, and fate of pollutants; Impacts of waste disposal on human health; Statutes and programs relating to marine waste disposal; Managing industrial effluents; Managing municipal effluent and sludge; Managing dredged material; Managing industrial wastes dumped in marine waters.

44117 **(PB—87-195905/XAB) Atlantic Outer Continental Shelf studies results: 1973-1985. Narrative summary.** Fritz, A.T. (Minerals Management Service, Vienna, VA (USA). Atlantic OCS Region). 1986. 31p. (OCS/MMS—86/0080). NTIS, PC A03/MF A01.

See also PB—87-195954.

The Minerals Management Service Offshore Environmental Studies Program was initiated in 1973 by the Secretary of the Interior to conduct studies needed to predict, assess, and manage impacts on the human, marine, and coastal environments of the Outer Continental Shelf (OCS) and nearshore areas that may be affected by oil and gas activities. The document summarizes the principal results of studies in the Atlantic OCS Region. Descriptions of studies results are divided into the following major types; physical processes, biologic, endangered species, and socioeconomic. Results of each major type of study are further divided chronologically by planning area: North Atlantic, Mid-Atlantic, and South Atlantic.

44118 **(PB—87-195954/XAB) Offshore environmental studies program: final reports, publications, and presentations. Summary report.** (Minerals Management Service, Vienna, VA (USA). Atlantic OCS Region). 1985. 71p. (OCS/MMS—85/0112). NTIS, PC A04/MF A01.

See also PB—87-194635.

The document is a summary of final reports, publications, and presentations resulting from the Atlantic Outer Continental Shelf (OCS) Region Studies Program. Final reports are a result of contracts with the private sector and academia or of agreements and memoranda of understanding with other federal agencies. Publications include federal agency technical reports and papers published in scientific journals. Presentations include scientific and less formal meetings where results of Studies funded by the Bureau of Land Management or the Minerals Management Service were discussed.

44119 **(PB—87-197620/XAB) Chromium valency response and environmental fate in three-phase aquatic microcosms. Master's thesis.** Conway, M.F. (Connecticut Univ., Storrs (USA). Inst. of Water Resources). 1984. 91p. NTIS, PC A05/MF A01.

Factors affecting the valency, solubility, transport, and biogeochemical fate of chromium in an aquatic environment were investigated and assessed utilizing a physical model. Three-phase, atmosphere-water-sediment, microcosms were utilized in a semi-continuous flow-through mode to model a river impoundment. Effects of varying chromium inputs on algal growth, sediment uptake rates, dissolved oxygen concentrations, chromium valency response, and ultimate fate of chromium were monitored. A concurrent study, conducted in an impoundment of the Naugatuck River in Thomaston, Connecticut, allowed field evaluation of responses observed in the microcosm models.

44120 **(PB—87-198313/XAB) Biological treatment of hazardous aqueous wastes.** Opatken, E.J.; Howard, H.K.; Bond, J.J. (Environmental Protection Agency, Cincinnati, OH (USA). Hazardous Waste Engineering Research Lab.). Jun 1987. 18p. (EPA—600/D-87/184). NTIS, PC A02/MF A01.

Studies were conducted with a rotating biological conractor (RBC) to evaluate the treatability of leachates from the Stringfellow and New Lyme hazardous-waste sites. The leachates were transported from the waste sites to Cincinnati at the United States Environmental Protection Agency's Testing and Evaluation Facility. A series of batches were run with primary effluent from Cincinnati's Mill Creek Sewage Treatment Facility. The paper reports on the results from these experiments and the effectiveness of an RBC to adequately treat leachates from Superfund sites.

44121 **(PB—87-198321/XAB) Biological treatment of aqueous hazardous wastes.** Park, J.E.; Koczwara, M.K.; Lesiecki, R.J. (Environmental Protection Agency, Cincinnati, OH (USA). Hazardous Waste Engineering Research Lab.). Jun 1987. 11p. (EPA—600/D-87/183). NTIS, PC A02/MF A01.

The paper describes tests performed in order to evaluate the fate of aqueous organic hazardous-waste compounds in the activated sludge process. Gas, liguid, and waste-solids samples were taken from acclimated activated-sludge systems to determine amounts that were volatilized, biodegraded, and associated with the wasted solids. Results discussed here include two compounds: methyl ethyl ketone and 1,1,1-trichloroethane.

44122 **(PB—87-198370/XAB) Geologic and atmospheric input factors affecting watershed chemistry in upper Michigan.** Rapp, G.; Liukkonen, B.W.; Allert, J.D.; Sorensen, J.A.; Glass, G.E. (Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab.). 1987. 19p. (EPA—600/J-87-034). NTIS, PC A02/MF A01.

Pub. in Environ. Geol. Water Sci., Vol. 9, No. 3, 155-171(Mar 1987).

The relationships between watershed variables and lakewater chemistry were examined for 53 lakes in the Upper Peninsula of Michigan to identify factors influencing lake sensitivity to atmospheric inputs. The lakes lie in three distinct geologic/geomorphic regions. Acid neutralization capacity (ANC), sulfate, and color were correlated with parameters related to atmospheric loading, watershed area and relief, hydrology, geology, and land use for the entire 53-lake set and for lower alkalinity subsets. Acid-neutralizing capacity was related to atmospheric acidic inputs and, in the southern portion of the Upper Peninsula, to the presence of mineralized groundwater inputs.

44123 **(PB—87-198396/XAB) In-situ restoration techniques for aquifers contaminated with hazardous wastes.** Lee, M.D.; Wilson, J.T.; Ward, C.H. (Environmental Protection Agency, Ada, OK (USA). Robert S. Kerr Environmental Research Lab.). 1987. 15p. (EPA—600/J-87-032). NTIS, PC A02/MF A01.

Pub. in Jnl. of Hazardous Materials 14, 71-82(1987).

Improper disposal of hazardous wastes is a threat to the nation's ground-water supply. Methods that prevent contamination are probably the most-effective techniques to protect ground water. Once contamination problems occur, there are a number of in-situ techniques that can be used to cleanse the ground water and at least partially restore the aquifer. Chemical and physical treatment techniques include processes such as neutralization, chemical reaction, extraction and immobilization. Biological techniques for in-situ treatment generally involve enhancing the degradative capacity of the indigenous microflora or the addition of organisms acclimated to degrade the contaminants.

44124 **(PB—87-199196/XAB) Magnitude and costs of groundwater contamination from agricultural chemicals: a national perspective. Staff report.** Nielsen, E.G.; Lee, L.K. (Economic Research Service, Washington, DC (USA). Natural Resource Economics Div.). Jun 1987. 61p. (AGES—870318). NTIS, PC A04/MF A01.

Evidence is mounting that agricultural pesticide and fertilizer applications are causing groundwater contamination in some parts of the United States. A synthesis of national data has enabled researchers to identify regions potentially affected by contamination from pesticides and fertilizers and to estimate the number of people in these regions who rely on groundwater for their drinking water

needs. The study found that pesticides and nitrates from fertilizers do not necessarily occur together in potentially contaminated regions.

44125 **(PB—87-200499/XAB) Humic substances isolated from surface sediments: analytical characteristics.** Schultz, D.M.; Miller, R.E. (Minerals Management Service, Vienna, VA (USA). Atlantic OCS Region). 1986. 133p. (OCS/MMS—86/0118). NTIS, PC A07/MF A01.

The elemental composition and infrared spectra of humic and fulvic acids isolated from Mid-Atlantic Continental Shelf and Slope surface sediments indicated relatively hydrogen-rich humic substance. The stable carbon isotopic ratios of the humic and fulvic acids range from -21.2 to -23.8 per mil with an average of -22.4 per mil. Pyrolysis-gas chromatographic patterns of humic acids and protokerogens showed longer carbon-chain length which are indicative of gas-condensate-to-oil prone, hydrogen-rich organic components. These humic substances are believed to be derived from a marine organic source and may be precursors in the formation of Type II kerogens. A succession of fulvic acid to humic acid to protokerogen is a possible evolutionary pathway for a portion of the protokerogens identified in this study.

44126 **(PB—87-201372/XAB) Analytical aspects of ozone treatment of water and wastewater - a monograph. Final report.** Rice, R.G.; Bollyky, L.J.; Lacy, W.J. (International Ozone Association, Norwalk, CT (USA)). Jun 1987. 438p. NTIS, PC A19/MF A01.

With the ever-increasing interest in the application of ozone for water and wastewater treatment, several major questions arise in the minds of those new to the field: (1) What is the nature of ozone. (2) How is ozone applied in water and wastewater treatment. (3) How is ozone used in its various applications. (4) How are the generation of ozone and ozonation reactions controlled analytically. (5) How are ozonation processes automated. Because ozone is a gas at normal temperatures and pressures, because it is only partially soluble in aqueous media, and because it decomposes in aqueous media at significant rates (i.e., with a half-life usually of less than one hour), analyses for ozone and control led ozone generation and ozonation reactions are unique to this advancing technology.

44127 **(PB—87-205159/XAB) Monitoring 1984: a first report from the Chesapeake Bay Program Monitoring Subcommittee. Summary report.** (Environmental Protection Agency, Annapolis, MD (USA). Chesapeake Bay Program). Sep 1985. 32p. NTIS, PC A03/MF A01.

See also PB—87-205175.

The study outlines the objectives, program structuring and sampling network. Objectives for the monitoring program are to: describe and track long-term trends; characterize the current state of the Bay; assure a Baywide perspective; serve as a useful support framework for ongoing and future studies; and make monitoring information widely available so that it can be used to help managers make decisions on the Bay's future.

44128 **(PB—87-205167/XAB) Chesapeake Bay restoration and protection plan.** (Environmental Protection Agency, Annapolis, MD (USA). Chesapeake Bay Liaison Office). Jul 1985. 118p. NTIS, PC A06/MF A01.

The report presents goals and strategies for improving the water quality and living resources of the Chesapeake Bay, for the sake of the Chesapeake's productivity, ecology, and to protect public health. It also outlines the activities of seven federal agencies and of four states.

44129 **(PB—87-205175/XAB) State of the Chesapeake Bay: second annual monitoring report, compendium. Report for January 1984-September 1985.** Lynch, M.P.; Krome, E.C. (Chesapeake Research Consortium, Inc., Gloucester Point, VA (USA)). Apr 1987. 177p. (CRC-PUB—125). NTIS, PC A09/MF A01.

See also PB—87-205159.

The report is a summary of information collected at stations around the Chesapeake Bay. It is designed to be a more detailed/technical companion to the State Of The Bay Summary Report. It reports the results of the monitoring of the Chesapeake Bay in terms of its physical and chemical makeup (sediments, the distribution of toxics), the living resources, (plankton, benthos, submerged aquatic vegetation, birds), and the Patuxent River, as a case history.

5203 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 43044, 43045, 43046, 43048, 43055, 43058, 43059, 43082, 43083, 43084, 43089, 43091, 43095, 43096, 43098, 43101, 43102, 43103, 43406, 44024, 44025, 44028, 44032, 44037, 44049, 44051, 44052, 44059, 44143, 44145, 44146, 44147, 44148, 44149, 44220

44130 **(PB—87-199162/XAB) Use of diagnostic measurements to enhance the selection and effectiveness of radon mitigation for detached dwellings. Technical report (Final).** Sanchez, D.C.; Hubbard, L.M.; Harrje, D. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). Jun 1987. 10p. (EPA—600/D-87/168). NTIS, PC A02/MF A01.

The paper discusses the use of diagnostic measurements to enhance the selection and effectiveness of radon mitigation for detached dwellings. The development of appropriate and cost-effective radon mitigation for a specific house is ultimately tied to the degree to which the authors understand the source of the indoor radon problem, how house characteristics affect radon-entry rates, and how candidate mitigation systems influence radon entry processes. Diagnostic measurements and procedures allow for qualitative and quantitative assessments of water, materials, and soil as sources of radon and the assessment of soil-gas-borne radon flow potentials related to indoor/outdoor differential pressure driving forces and soil-air permeability. The discussed diagnostics are being developed and tested as part of an intensive State and Federal government study of radon entry and mitigation processes in 14 Piedmont, New Jersey houses.

44131 **(STUK-A—66) Finnish studies on radioactivity in the Baltic Sea after the Chernobyl accident. Supplement to Annual Report STUK-A55.** Ilus, E.; Sjoeblom, K.L.; Saxen, R.; Aaltonen, H.; Taipale, T.K. (Finnish Centre for Radiation and Nuclear Safety, Helsinki). Apr 1987. 40p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87752412.

After the Chernobyl accident extensive studies were started in the Baltic Sea area. Samples of sea water, bottom sediment, fish, plnkton, littoral algae and benthic animals were collected for radionuclide analyses. All the samples were analysed gammaspectrometrically. From some of the samples "8"9Sr, "9"0Sr and transuranic elements were determined. The fallout from the Chernobyl accident was areally unevenly distributed, contrary to the fallout situation in the 1960s. This also reflects in the results of the measurements in the marine environment. After the decay of short-lived radionuclides, "1"3"7Cs and "1"3"4Cs were the most important nuclides. The "1"3"7Cs concentrations in sea water were considerably higher in 1986 than the values reported from the 1960s. Due to the low accumulation of caesium isotopes in brackish-water fish, the concentrations in Baltic Sea fish were clearly lower than in freshwater fish. Thus the consumption of Baltic fish contributes only insignificantly to internal radiation doses of Finnish people.

5204 Thermal Effluents Monitoring And Transport

REFER ALSO TO CITATION(S) 44142, 44146, 44151, 44152, 44153, 44154, 44155, 44156

44132 (SRO—819-17, pp 97-103) **Larval fish assemblages along reactor thermal plumes in a riverine swamp system.** Aho, J.M.; Anderson, C.S. Sep 1986. NTIS, PC A09/MF A01. File Number DE87012054.

In Ecological research at the Savannah River Ecology Laboratory: Annual report for the period ending July 31, 1986.

The purpose of this study was to examine patterns of reproductive phenology in the fish of the extensive Savannah River Swamp System (SRSS). Environmental perturbations in the form of heated effluents and an erratic, fluctuating hydrologic regime allow study of the importance of abiotic factors on reproduction in resi-

dent fishes. The questions asked were: (1) Does elevated water temperature affect the timing and phenology of larval fish recruitment? (2) Dose species-specific recruitment occur at identical temperatures or do fish in unimpacted areas occur at cooler temperatures because of additive photoperiod effects? (3) Do reproductive activity and success depend on changes in water level? 3 figures, 1 table.

44133 (SRO—819-17, pp 121-125) **Winter activity and survival of crocodilians in thermally altered and non-altered environments.** Seigel, R.A.; Brandt, L.A.; Novak, S.S. Sep 1986. NTIS, PC A09/MF A01. File Number DE87012054.

In Ecological research at the Savannah River Ecology Laboratory: Annual report for the period ending July 31, 1986.

The American alligator population on the Savannah River Plant is exposed to much colder winters than occur in most other parts of the species' geographic range. Although both activity patterns and survival may be affected by severe weather, the direct effects of harsh environmental conditions on alligators are poorly known. In addition, several populations of alligators on the SRP inhabit areas that are thermally altered, and may show different responses than do alligators in non-altered areas. In this report, the authors present information on two related topics: the annual activity patterns of alligators inhabiting thermally altered and non-altered areas, and the effects of freezing temperatures on the survival and behavior of juvenile alligators. 1 figure.

5205 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 42970, 43138, 44128, 44129, 44133

44134 (DOE/BP—725, pp 1-24) **Lochsa river tributaries enhancement proposal.** Talbert, D.E.; Espinosa, F.A. Jr. Sep 1986. NTIS, PC A 14. File Number DE87009928.

In Natural propagation and habitat improvement: Volume 2, Idaho: Annual and final reports, 1985.

In 1984, the Clearwater National Forest and Bonneville Power Administration entered into a contractual agreement (Project 84-31) to identify potential enhancement projects for anadromous fish in the Clearwater River Basin. The primary objectives of this project were to survey potential streams and identify opportunities to mitigate for the effects of past and present influences. Selected tributaries of the Lochsa River were determined to be suitable for this type of project. Four Lochsa River tributaries on the Lochsa Ranger District were identified as candidates for habitat mitigation. These streams were Walde, Deadman, lower Fish, and Boulder Creeks. These streams were surveyed and analyzed to determine: 1) limiting factors to fish production; 2) the extent and severity of these limitations, and; 3) the feasibility of eliminating and/or mitigating these factors. A plan was developed to display appropriate projects and costs associated with mitigating the impacts of identified limiting factors on fish.

44135 (DOE/BP—725, pp 25-91) **Lochsa River tributaries enhancement proposal.** Kramer, R.P.; Seloske, G.C.; Espinosa, F.A. Jr. Sep 1986. NTIS, PC A 14. File Number DE87009928.

In Natural propagation and habitat improvement: Volume 2, Idaho: Annual and final reports, 1985.

In 1984, and under the auspices of the Northwest Power Act, the Clearwater National Forest and Bonneville Power Administration entered into a contractual agreement (Project 84-31) to identify potential enhancement projects for anadromous fish in the Clearwater River Basin. The Lochsa River and its tributaries provide excellent opportunities for such a project. The primary objectives of this project were to survey potential streams and identify opportunities to mitigate for the effects of past and present influences. Data was collected and analyzed to determine the source of local impacts, the extent and severity of the impacts, the feasibility of eliminating and/or mitigating these impacts, and identifying potential improvement areas geared towards improving the productive capability of the system. Three drainages were identified as possessing prime opportunities for mitigation practices. They are Squaw Creek; Doe Creek, a tributary of Squaw Creek; and Papoose Creek. A mitigation plan was developed which outlines proposed habitat enhancement structure types, their locations, and the cost of implementation of the proposal.

44136 (DOE/BP—725, pp 92-136) **Eldorado Creek Fish Passage. Final report.** Murphy, W.; Espinosa, A. Jr. Sep 1986. NTIS, PC A 14. File Number DE87009928.

In Natural propagation and habitat improvement: Volume 2, Idaho: Annual and final reports, 1985.

Following the recommendations set forth in the 1984 Eldorado Creek Fish Passage Annual Report, the length, width, and depth of the pools created in 1984 were improved. These modifications permitted more anadromous fishes to reach the spawning areas.

44137 (DOE/BP—725, pp 137-193) **Eldorado Creek: a plan for enhancement of key anadromous fish habitat in the Clearwater River Basin.** Espinosa, A. Jr. Vogelsang, R.; Murphy, W. Sep 1986. NTIS, PC A 14. File Number DE87009928.

In Natural propagation and habitat improvement: Volume 2, Idaho: Annual and final reports, 1985.

This document describes the reasons for and recommended methods of, enhancing anadromous fish habitat in Eldorado Creek. Enhancement is recommended for both impacted and natural reaches in main Eldorado Creek and six of its major tributaries: Fan, Trout, Lunch, Four-Bit, Dollar, and Six-Bit Creeks. Enhancement activities will benefit spawning habitat (2.5 acres) and rearing habitat (54 to 64 acres). Smolt production capability is expected to increase by 200%. To achieve this goal it is estimated that a total of 346 fish habitat improvement structures will be necessary. It is estimated that the project will take 4 years, at an estimated total cost of $86,775. This proposal is part of a comprehensive effort by the Clearwater National Forest to improve the quantity and quality of anadromous fish habitat. With the cooperation and guidance of the Bonneville Power Administration, intensive habitat improvement projects have been successfully completed on several of the tributaries of the Clearwater River. This proposal represents a continued commitment to this program.

44138 (DOE/BP—725, pp 194-259) **Upper Crooked Fork fish barrier removal.** Kramer, R.P.; Oman, E.M.; Espinosa, F.A. Jr. Sep 1986. NTIS, PC A 14. File Number DE87009928.

In Natural propagation and habitat improvement: Volume 2, Idaho: Annual and final reports, 1985.

Crooked Fork Creek is one of the principal tributaries of the Lochsa River. It contains the bulk of the remaining high quality spawning and rearing habitats for anadromous fish on the Clearwater National Forest. It is estimated that 25% of the total chinook salmon and 25% of the total steelhead smolt production of the Clearwater National Forest emanate from this drainage. The long-term ability to restore anadromous fish runs to the upper Lochsa system is dependent upon increasing the available spawning habitat in the Crooked Fork drainage. Stream and habitat surveys performed in 1983 on the Crooked Form established that several natural waterfalls and rock chutes totally preclude upstream migration of spring chinook salmon during late summer flows. At some high flows summer steelhead are able to negotiate the barriers. Seven major barriers and five partial barriers were drilled and blasted in the summer of 1984. Following evaluation in 1985, six of the major barriers and resting areas, and four of the partial barriers required additional work. Deep take-off pools, resting areas, and gentler gradients were created to increase fish passage. An additional barrier was identified on Hopeful Creek, a tributary of the Crooked Fork, and was removed.

44139 (DOE/BP—725, pp 260-281) **South Fork Clearwater River habitat enhancement.** Hair, D.; Stowell, R. Sep 1986. NTIS, PC A 14. File Number DE87009928.

In Natural propagation and habitat improvement: Volume 2, Idaho: Annual and final reports, 1985.

In 1927 a dam was constructed on the South Fork of the Clearwater River at Harpster, which totally eliminated anadromous fish runs into this important spawning and rearing habitat. In 1962 the dam was completely removed. By this time, however, the anadromous runs had been eliminated from the drainage. The USFS began a program of active habitat improvement in the Red River, Crooked River, and Newsome Creek drainage systems in 1980. These are continuing on an annual basis utilizing Forest Service

funding. Since the BPA project proposal has been approved, the Red River District has directed its emphasis to the South Fork of Red River, and the Elk City District has concentrated on Newsome Creek. These projects will complement the BPA work being carried out in Red River and Crooked River. The USFS contribution to the rehabilitation of the South Fork Clearwater system was $7800 in 1983, $30,157 in 1984, $96,347 in 1985, and is projected to be $120,000 in 1986.

44140 **(DOE/BP—757) Pacific Northwest Rivers Study: Assessment guidelines: Oregon.** (Oregon State Dept. of Energy, Salem (USA)). Dec 1986. 72p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87011209.

This document presents the process that the state and federal agencies and Indian tribes followed to complete the Pacific Northwest Rivers Study. It identifies assessment guidelines for river resource categories and provides reporting formats for data collection and presentation.

44141 **(DOE/BP/39643—2) Use of a fish transportation barge for increasing returns of steelhead imprinted for homing.** (National Marine Fisheries Service, Seattle, WA (USA). Coastal Zone and Estuarine Studies Div.). Jun 1987. Contract AI79-83BP39643. 53p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87013417.

In 1982, the National Marine Fisheries Service began a 6-year study to determine if transporting steelhead, Salmo gairdneri, smolts by barge from Dworshak National Fish Hatchery (NFH) to a release site on the Columbia River below Bonneville Dam would result in increased returns of adults to the various fisheries and to the hatchery homing site. During 1982 and 1983, over 500,000 juveniles were marked and serially released as controls from the hatchery or barged as test fish to below Bonneville Dam. As of July 1986, returns of adults to various recovery sites from juveniles released in 1982 are virtually complete. Returns of one- and two-ocean fish from the 1983 release are nearly complete. The 1983 test releases showed much less homing impairment and delay in upstream migration than 1982 releases. Most adults from both control and test releases in 1983 and control releases in 1982 migrated a considerable distance upstream and overwintered in the Snake and Clearwater Rivers - behavior similar to Clearwater River fish previously transported from Lower Granite Dam. In contrast, many of the adults from test releases in 1982 failed to migrate upstream very far in the fall and overwintered in the Columbia River.

44142 **(DPST—86-796) The distribution of ichthyoplankton in thermal and non-thermal creeks and swamps on the Savannah River Plant, February-July 1985.** Paller, M.H.; Saul, B.M.; Hughes, D.W. (Environmental and Chemical Sciences, Inc., Aiken, SC (USA)). Jan 1986. Contract AC09-76SR00001. 279p. (ECS-SR—25). NTIS, PC A13/MF A01; 1; GPO Dep. File Number DE87013050.

The report deals with the distribution of ichthyoplankton in the Savannah River tributary streams and associated swamps located on the SRP during the 1985 spawning season (February-July). The 1985 sampling program was a continuation of the 1984 program and, except for the addition of seven sampling stations and minor methodological changes, incorporated the same sampling sites and procedures. The streams under study were Upper Three Runs Creek, Beaver Dam Creek, Four Mile Creek, Pen Branch, Steel Creek, Meyer's Branch and Lower Three Runs Creek. The objectives were to determine: (1) the density, distribution and species composition of ichthyoplankton at sample sites in the creeks and swamps of the SRP; (2) how ichthyoplankton in SRP creeks and swamps is distributed in relation to habitat and temperature; (3) the effects of elevated temperatures on ichthyoplankton distribution and abundance and on the time of spawning; and (4) the magnitude of yearly variations in ichthyoplankton abundance in the creeks and swamps of the SRP and the reasons for these variations.

44143 **(K/SUB—85-22224/2) Ground-water monitoring plan for selected waste handling facilities at the Oak Ridge Gaseous Diffusion Plant: Final report.** Kuhlmeier, P.D.; Sinclair, W.C.; Haymore, J.L. (Oak Ridge Gaseous Diffusion Plant, TN (USA); Geraghty and Miller, Inc., Oak Ridge, TN (USA)). Jul 1986. Contract AC05-84OT21400. 68p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87010836.

Ground-water characteristics at 29 waste handling sites were monitored for potential contamination of ground water. Geologic and hydrologic data collected during the drilling and testing of the wells were used in the characterization of the hydrogeology at each of the sites. Conclusions contained in that report are the basis for the location of monitor wells. To provide hydrologic and water-quality data; determine the presence, concentration, and extent of pollutants; and meet current state and federal regulations.

44144 **(PB—87-198552/XAB) National water summary 1985--hydrologic events and surface-water resources.** Moody, D.W.; Chase, E.B.; Aronson, D.A. (Geological Survey, Reston, VA (USA). Water Resources Div.). 1986. 519p. (USGS-WSP—2300). NTIS, PC A22/MF A01.

See also PB—87-185062; Color illustrations reproduced in black and white.

The summary for 1985 is the third of an annual series by the USGS that describes the conditions, trends, variability, quality, and use of the Nation's water resources. An overview is presented of the distribution, characteristics, uses, and management of the surface-water resources in each of the States and the territories. Each State summary contains multicolor maps showing the location of principal river basins, rivers, reservoirs, hydropower plants, graphs showing average annual discharges and average seasonal variations in precipitation and runoff; and tables presenting streamflow and water-use statistics. Also described are State agencies, laws, and regulations pertaining to surface-water management.

44145 (SRO—819-17, pp 7-11) **Metal and radionuclide concentrations in L-lake sediments.** Adriano, D.C.; Burkman, W.G.; Bowling, J.W.; Strojan, C.L. Sep 1986. NTIS, PC A09/MF A01. File Number DE87012054.

In Ecological research at the Savannah River Ecology Laboratory: Annual report for the period ending July 31, 1986.

The cycling of iron, manganese and other metals can have important ecological implications in acidic southeastern lakes and reservoirs. When water in a lake's hypolimnion is anoxic, as typically occurs in summer, the solubility of certain elements, such as iron and manganese, increases. During such anoxic conditions, remobilization of elements from lake sediments into the hypolimnion may also occur. Concentrations of these elements can reach levels that are toxic to organisms. Perhaps more importantly, when turnover of the water column occurs in autumn, oxygenation of the anoxic hypolimnion may cause precipitation of metal oxides, forming colloids that can be harmful to fish and other organisms, e.g., by physically obstructing gills. all of these processes can have bearing on the development of a balanced biological community in L-Lake. The inventory of metal and radionuclide concentrations in L-Lake basin sediments will be used to assess potential remobilization of these elements from the lake sediments into the overlying water column. These data will be used in conjunction with laboratory microcosm studies and lake measurements to determine the potential for element remobilization under existing lake conditions. 1 figure, 2 tables.

44146 (SRO—819-17, pp 12-16) **Utilization of selective dissolution methods for assessing ^{137}Cs mobility and bioavailability.** Noll, M.R.; Bertsch, P.M. (Univ. of Delaware, Newark). Sep 1986. NTIS, PC A09/MF A01. File Number DE87012054.

In Ecological research at the Savannah River Ecology Laboratory: Annual report for the period ending July 31, 1986.

The establishment of L-Lake for receiving thermal effluent from the newly reactivated L-Reactor has raised some concern about possible remobilization of ^{137}Cs from the Steel Creek floodplain sediments. To assess the potential for ^{137}Cs remobilization and bioavailability under specific environmental conditions, information on cesium distribution among the various solid phase components is

required. The objective of this investigation was to develop a method for estimating the various chemical forms of ^{137}Cs in sediments employing a sequential selective dissolution (SSD) technique that could be utilized in assessing potential bioavailability. 3 figures, 1 table.

44147 (SRO—819-17, pp 17-22) **Inventories ^{137}Cs, ^{90}Sr and /sup 239,240/Pu in pond B: implications for the relative importances of radionuclide cycling processes in lake ecosystems.** Whicker, F.W.; Bowling, J.W.; Kelly, M.S.; Pinder, J.E. III; Orlandini, K.A.; Alberts, J.J. (Colorado State Univ., Fort Collins). Sep 1986. NTIS, PC A09/MF A01. File Number DE87012054.

In Ecological research at the Savannah River Ecology Laboratory: Annual report for the period ending July 31, 1986.

Although radionuclide cycling studies have been performed in Pond B, Par Pond and other lake and pond habitats on the Savannah River Plant, there have been few studies designed to estimate total radionuclide inventories or the inventories in various components of these ecosystems. Because inventory data were lacking for SRP lakes and for southeastern lakes in general, a study was initiated in 1983 to inventory the ^{90}Sr, ^{137}Cs and /sup 239,240/Pu contents of Pond B sediments and biota. The inventory study was conducted concurrently with research on radionuclide cycling processes in the water column. The radionuclide inventories in the sediments were determined from randomly located sediment cores taken from throughout the pond. Samples were also collected at various times of the year to estimate the radionuclide contents of the water column. The appropriate samples were also collected to estimate the biomass and radionuclide inventories in the major biological components of the pond. Data were obtained on macrobenthic organisms and various vertebrate species, but the greatest emphasis was placed on estimating the biomass and radionuclide contents of the aquatic macrophytes. Approximately 40% of the 87 ha area of Pond B is less than 3 m deep, and this large shallow area supports approximately 140 metric tons of macrophyte biomass. 4 figures.

44148 (SRO—819-17, pp 23-27) **Settling rates of plutonium-bearing particles in Pond B.** Orlandini, K.A.; Bowling, J.W.; Pinder, J.E. III. (Argonne National Lab., IL). Sep 1986. NTIS, PC A09/MF A01. File Number DE87012054.

In Ecological research at the Savannah River Ecology Laboratory: Annual report for the period ending July 31, 1986.

Research is being conducted in Pond B to determine the relative importances of (1) changes in particles settling rates, (2) changes in remobilization rates, and (3) the influence of the macrophytes on the annual cycle in /sup 239,240/Pu inventories. The initial research has emphasized (1) an evaluation of the importance of particle adherence to macrophytes in reducing Pu inventories in the water column and (2) measurements of particle settling rates at different times of the year. This report describes the research on measurements of particle settling rates. 3 figures, 1 table.

44149 (SRO—819-17, pp 28-33) **Environmental chemistry of sodium tetraphenylboron: photochemical degradation.** Mills, G.L.; Carter, D.J. Sep 1986. NTIS, PC A09/MF A01. File Number DE87012054.

In Ecological research at the Savannah River Ecology Laboratory: Annual report for the period ending July 31, 1986.

Savannah River Plant operations over the past 30 years have generated over 78 million gallons of radioactive wastewater. The major radioactive contaminant in the wastewater is ^{137}Cs. Sodium tetraphenylboron (NaTPB) will be used to precipitate ^{137}Cs from the stored waste as part of the operations of the new Defense Waste Processing Facility (DWPF). DWPF operations will require about 500,000 gallons of a 1 molar TPB solution annually, which will be transported and stored at the SRP. These activities can potentially result in the release of NaTPB into soil or aquatic environments. Studies have been undertaken to assess its chemical behavior and toxic effects. 4 figures, 3 tables.

44150 (SRO—819-17, pp 38-42) **Chemical speciation and transport of heavy metals in SRP aquatic systems.** Bertsch, P.M.; Loehle, C.; Anderson, M.A.; Elrashidi, M.A. Sep 1986. NTIS, PC A09/MF A01. File Number DE87012054.

In Ecological research at the Savannah River Ecology Laboratory: Annual report for the period ending July 31, 1986.

In an attempt to provide predictive capabilities and thus better understanding for the transport of heavy metals and radionuclides in SRP aquatic systems, the chemical speciation-transport model MEXAMS (Metal Exposure Analysis Modeling System) has been implemented and is being tailored for site-specific application to SRP aquatic systems as influenced by reactor cooling water discharges. Speciation simulations of Pb, Cd, Ni, Zn, and Cu were performed.

44151 (SRO—819-17, pp 47-53) **Wetland forest regeneration and hydrologic regime.** Sharitz, R.R.; Schneider, R.L.; Dyer, K.W.; Martin, N.C. Sep 1986. NTIS, PC A09/MF A01. File Number DE87012054.

In Ecological research at the Savannah River Ecology Laboratory: Annual report for the period ending July 31, 1986.

Major factors that limit regeneration of bald cypress (Taxodium distichum) and water tupelo (Nyssa aquatica) include: (1) low seed production, viability, and dispersal, (2) lack of suitable substrates for germination, and (3) hydrologic conditions that limit germination and seedling survivorship. An evaluation of the relative importance of these factors on regeneration success of bald cypress and water tupelo in the 3800-ha Savannah River floodplain forest on the SRP has been conducted from 1984-1986. Tree regeneration in natural and disturbed swamp systems on the SRP is of particular concern for wetland management; however little is known about seed demography of wetland forest species. Studies were conducted on seed production, viability, and mortality of populations of water tupelo and bald cypress, codominants in the SRP floodplain forests. Other topics of discussion include seed dispersal and substrate availability and hydrologic conditions in the SRP floodplain forests. Cooling water discharges from SRP reactors and control of Savannah River discharges by upstream dams have modified the hydrologic regime of the river floodplain on the SRP. 4 figures, 2 tables.

44152 (SRO—819-17, pp 91-96) **Natural variation in stream and wetland ecosystems and the effects of Defense Waste Processing Facility construction.** Knox, J.N.; Pechmann, J.H.K.; Scott, D.E. Sep 1986. NTIS, PC A09/MF A01. File Number DE87012054.

In Ecological research at the Savannah River Ecology Laboratory: Annual report for the period ending July 31, 1986.

In 1973 the Atomic Energy Commission (AEC) initiated a research and development program on immobilization of high-level radioactive waste generated at the SRP. One result of this program was the planning and subsequent construction of the Defense Waste Processing Facility (DWPF). The Department of Energy (DOE) recognized that construction of the DWPF might affect biota on and near the construction site, and therefore contracted SREL to conduct ecological studies in streams and wetlands of special concern. Research began at a 1-ha Carolina bay (Sun Bay) on the construction site (243 ha) in 1978. Vegetation was categorized and initial faunal surveys were conducted. This initial biological inventory revealed that the site was particularly important as a breeding habitat for amphibian species. Because Sun Bay was to be eliminated by construction, a nearby wetland (Rainbow Bay) similar in floral and faunal community composition was chosen for use as a control site. This has allowed the continued collection of baseline information on Representative Important Species (RIS), and enabled assessment of the impact of DWPF construction on the local Sun Bay amphibian population. Construction effects on water quality in streams draining the site have also been examined. Thus, the primary objectives of SREL research related to DWPF are to: (1) provide a preconstruction biological inventory of the DWPF site and alternative sites, (2) collect ecological baseline information on RIS, (3) monitor and assess the potential impact of construction on peripheral stream water quality, and (4) evaluate the success of mitigation measures undertaken by DOE. 3 figures.

44153 (SRO—819-17, pp 104-110) **Habitat associations of fish assemblages in small streams of the SRP.** Meffe, G.K.; Sheldon, A.L. Sep 1986. NTIS, PC A09/MF A01. File Number DE87012054.

In Ecological research at the Savannah River Ecology Laboratory: Annual report for the period ending July 31, 1986.

Southeastern blackwater streams of the Atlantic Coastal Plain have been virtually unstudied with respect to fish community structure. On the Savannah River Plant this is particularly unfortunate since local streams, which have been perturbed by nuclear activities, cannot be quantitatively compared with normal systems to determine extent of community disruption or to minimize impact. The authors purpose is to present descriptive, quantitative information on fish community structure in natural streams of the SRP relative to habitat components, for use in assessment of damage to impacted streams and in management of and mitigation for these sites. Their goal is to understand fish distribution and abundance at the mesohabitat level, which is below the macro, or geographic, scale and above the microhabitat scale. The authors are interested in fish distributions at the scale of meters, and ask how local habitat structure relates to local fish assemblage structure. The authors samples fishes from many sites, collected extensive habitat data at each one, and compared variation in fish assemblage structure with variation in habitat structure. 4 figures, 2 tables.

44154 (SRO—819-17, pp 111-114) **Biomass productivity of freshwater turtles.** Congdon, J.D.; Gibbons, J.W. Sep 1986. NTIS, PC A09/MF A01. File Number DE87012054.

In Ecological research at the Savannah River Ecology Laboratory: Annual report for the period ending July 31, 1986.

The biomass production of both soma and eggs of a six-species turtle community from a Carolina bay on the SRP was compared with that of a three-species turtle community in a marsh in southeastern Michigan. The authors purpose was to assess the role and importance of freshwater turtles in natural wetland habitats. 1 table.

44155 (SRO—819-17, pp 115-120) **Dispersion of radioactively contamination turtles on the SRP: research and reconnaissance.** Lamb, T.; Taylor, B.; Gibbons, J.W. Sep 1986. NTIS, PC A09/MF A01. File Number DE87012054.

In Ecological research at the Savannah River Ecology Laboratory: Annual report for the period ending July 31, 1986.

Although SREL continued long-term studies on turtles during 1986, much research effort centered on contaminated turtle dispersion. The problem of radionuclide contamination in turtles and their dispersal through aquatic sites on and off the Savannah River Plant (SRP) was approached along three fronts. The first involved site reconnaissance, where aquatic habitats, adjacent to contaminated areas on the SRP were identified and surveyed for contaminated turtles. The second approach involved the development of a dispersal model. Third, mitochondrial DNA analysis was conducted to assess genetic differentiation between turtle populations inhabiting either side of the Savannah River near SRP. 1 figures, 2 tables.

44156 (SRO—819-17, pp 130-134) **Ecology of waterfowl populations on the SRP.** Hepp, G.R.; Kennamer, R.A.; Hoppe, R.T. Sep 1986. NTIS, PC A09/MF A01. File Number DE87012054.

In Ecological research at the Savannah River Ecology Laboratory: Annual report for the period ending July 31, 1986.

Waterfowl are major primary and secondary consumers in wetlands of the SRP, and are also economically important as popularly harvested game species. Additionally, because of their migratory nature, they are of concern to the operation of the SRP as potential vectors of radionuclides off the site. Waterfowl use the SRP during two distinct time periods: (1) from mid-autumn until early spring several species of migratory waterfowl use the area; and (2) during spring and summer breeding wood ducks, Aix sponsa, use the SRP. SREL is currently conducting two long-term waterfowl research projects. The first is an assessment of waterfowl use of the SRP during the wintering season. The second project is a study of the breeding ecology of wood ducks in a post-thermal drainage system. 3 figures, 2 tables.

5206 Regulations

REFER ALSO TO CITATION(S) 43054, 44069, 44070, 44072, 44076, 44077, 44078, 44079, 44080, 44081, 44082, 44084, 44085, 44086, 44087, 44089, 44090, 44091, 44092, 44093, 44094, 44095, 44096, 44097, 44098, 44099, 44100

44157 **(PB—87-188561/XAB) Superfund Record of Decision (EPA region 3): Chisman Creek Site, Grafton, York County, Virginia, September 1986. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 30 Sep 1986. 51p. (EPA/ROD/R—03-86/030). NTIS, PC A04/MF A01.

The Chisman Creek site, located in Southeastern York County, VA, is in a 520-acre sub-watershed of the Chisman Creek coastal Basin on the Virginia Peninsula. As a tidal estuary, Chisman Creek flows easterly into Chesapeake Bay. Chisman Creek supports private and commercial marinas and numerous private docks, and is also a popular fishing area. In 1957 and 1958, two units of the Virginia Power Yorktown Power Generating Station began burning coal mixed with coke from a nearby petroleum refinery. Fly ash was produced by these units until 1974. A private contractor, employed between 1957 and 1974 to haul the fly ash from the generating station, disposed of large quantities of this incinerated coal by-product in four abandoned sand and gravel pits in the Chisman Creek watershed, approximately two miles south of the generating station. No dust control measures were employed during the hauling, and uncontrolled erosion caused fly ash to wash from the pits into Chisman Creek and its tributaries during heavy rains. The primary contaminants of concern include: trace metals (nickel and vanadium), and inorganics.

44158 **(PB—87-188835/XAB) Superfund Record of Decision (EPA region 2): Kentucky Avenue Wellfield, Town of Horseheads, Chemung County, New York, September 1986. Final report.** (Environmental Protection Agency, Washington, DC (USA)). Sep 1986. 67p. (EPA/ROD/R—02-86/027). NTIS, PC A04/MF A01.

The kentucky Avenue Well Field, part of the Elmira Water Board (EWB) public water supply system, covers approximately 12 square miles in the south central part of Chemung County, New York. The Kentucky Avenue Well Field, part of the EWB network of wells and reservoirs serving area residents, was closed in September 1980 following the discovery of elevated levels of TCE. The primary contaminants of concern include: TCE, VOCs, and chlorinated solvents.

44159 **(PB—87-188850/XAB) Superfund Record of Decision (EPA region 2): Brewster Well Field, Brewster, Putnam County, New York, September 1986. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 30 Sep 1986. 58p. (EPA/ROD/R—02-86/036). NTIS, PC A04/MF A01.

The Brewster Well Field, located on the northern bank of the East Branch Croton River, is three-quarters of a mile east of the Village of Brewster, Town of Southeast, Putnam County, NY. Since 1954 when Well Field No. 1 was developed, the Village of Brewster has used the aquifers beneath the Village-owned land as a water supply source. In 1967 Well Field No. 2 was brought on line. In 1978 evidence of volatile halogenated organic compound contamination from an unidentified source first appeared. VHOs have been the primary contaminants detected in the ground water. The principal contaminants were found to be tetrachloroethylene, trichloroethylene, and 1,2-dichloroethylene.

44160 **(PB—87-189049/XAB) Superfund Enforcement Decision Document (EPA region 5): A and F Materials Company, Greenup, Illinois, August 1986. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 14 Aug 1986. 85p. (EPA/ROD/R—05-86/045). NTIS, PC A05/MF A01.

The A&F Materials site is located on three and three-quarter acres in Greenup, IL. The site, originally an undeveloped backwater flood zone for the Embarras River, was first developed for a sawmill operation. Mr. Ken Ault purchased the site for the A&F Materials recycling plant, which began operations in March 1977

and continued until it shut down in 1980. The plant processed waste materials (including but not limited to oil, sludge, caustic and sulfuric acid) into fuel oil and fire-retardant chemicals. During the course of operations, there were numerous violations of the operating permit issued to the plant by the IEPA. By March 1978, four storage lagoons became filled and began to overflow, contaminating the soil and drainage pathway. In addition, thirteen steel storage tanks containing a mixture of waste oils (contaminated with PCBs and organics), sludges, spent caustics and acids, contaminated water and other waste products, were located onsite. The most significant contaminants of concern found during the RI/FS include: sulfates, inorganics, TCE, and metals.

44161 **(PB—87-189403/XAB) Superfund Record of Decision (EPA region 8): North Dakota Arsenic Trioxide in Southeastern North Dakota, September 1986. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 26 Sep 1986. 32p. (EPA/ROD/R—08-86/007). NTIS, PC A03/MF A01.

The North Dakota Arsenic Trioxide site consists of twenty townships in Richland, Ransom, and Sargent counties in southeastern North Dakota. Ground water use includes residential consumption, irrigation, and livestock watering. The contamination, limited to ground water, appears to have two sources; naturally occurring arsenic contained in shales native to the area; and an estimated 330,000 pounds of arsenic-laced bait used to control grasshopper infestations in the 1930s and 1940s. The primary contaminant of concern is arsenic trioxide.

44162 **(PB—87-189866/XAB) Superfund Record of Decision (EPA region 1): Kellogg-Deering Well Field, Norwalk, Connecticut, September 1986. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 25 Sep 1986. 46p. (EPA/ROD/R—01-86/019). NTIS, PC A03/MF A01.

The Kellogg-Deering Field is owned and operated by the Norwalk First Taxing District Water Department (NFTD). The primary source of public water supply to the NFTD is surface water from four reservoirs, with ground water as a secondary source. In 1975, trichloroethylene (TCE) was discovered in the ground water. Other identified contaminants include: PCE, 1-2-DCE, methylene chloride, xylenes, and benzene. The selected remedial action for this site involves air stripping of the contaminated ground water and subsequent discharge into the existing conventional water treatment plant and distribution system; and air and ground water monitoring.

44163 **(PB—87-189874/XAB) Superfund Record of Decision (EPA region 8): Libby Ground Water Contamination Site, Libby, Montana, September 1986. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 26 Sep 1986. 126p. (EPA/ROD/R—08-86/006). NTIS, PC A07/MF A01.

Abandoned wood-treating operations on the mill property are the source of ground-water contamination at the Libby Ground Water Contamination site in the northwest corner of Montana. In 1979, shortly after installation of private wells, some homeowners detected the presence of a creosote odor, and EPA monitoring in 1981 confirmed ground-water contamination. Based on 1984 well sample results, Champion International Corporation implemented the Buy Water Plan. Under this program, individuals with contaminated ground water wells agree to cease using their wells and use water from the public water system operated by the City of Libby. The program, indefinite in term, would be terminated upon the elimination of the threat of contamination, if the well owner provides a written termination notice, or if other alternatives become available. The primary contaminants of concern include: VOCs, PAHs, PCP, organics, inorganics, heavy metals, and creosote. Selected remedies are proposed and included in the report.

44164 **(PB—87-189882/XAB) Superfund Record of Decision (EPA region 8): Marshall Landfill Site, Boulder County, Colorado, September 1986. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 26 Sep 1986. 57p. (EPA/ROD/R—08-86/008). NTIS, PC A04/MF A01.

The Marshall Landfill accepted unstabilized sewage sludge and many unidentified and potentially hazardous wastes. Septic wastes and liquid industrial wastes were also disposed offsite in two, now closed, septic ponds. The primary contaminants of concern include: VOCs including TCE, PCE, DCE, and benzene, and heavy metals including cadmium and lead. The selected remedial action includes: installation of a subsurface collection system using natural ground water gradients to collect all contaminated ground water leaving the Marshall Landfill site; treatment of contaminated ground water by sedimentation, air stripping, and off-gas carbon adsorption; landfill improvements, including regrading, revegetation, perimeter ditches, and fences, to minimize future environmental and public health impacts from the site, and ground and surface water monitoring.

44165 **(PB—87-189916/XAB) Superfund Record of Decision (EPA region 6): Odessa Chromium 2, Odessa, Texas, September 1986. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 8 Sep 1986. 42p. (EPA/ROD/R—06-86/011). NTIS, PC A03/MF A01.

The Odessa Chromium II site consists of a series of chromium-contaminated wells. Nearly every residence or commercial facility is served by one or more water wells completed in the Trinity aquifer which offers the only source of potable groundwater. The primary contaminant of concern is chromium. The selected remedial action includes: extension of municipal water service to the affected area of the site. This involves negotiations with the city and local residents.

44166 **(PB—87-189924/XAB) Superfund Record of Decision (EPA region 4): Mowbray Engineering Company, Greenville, Alabama, September 1986. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 25 Sep 1986. 77p. (EPA/ROD/R—04-86/012). NTIS, PC A05/MF A01.

The Mowbray Engineering Company (MEC) site consists of a 3-acre swamp located in Greenville, Butler County, Alabama. An aquifer underlying the site supplies 11,400 residents with potable water. Waste oils were dumped onto the ground behind the plant. Oil was also allowed to flow into a city storm sewer drain and ultimately into the swamp. Dumping and other discharges continued until the mid 1970s. MEC installed two underground storage tanks to collect oils for resale and prevent spills. PCBs were detected in swamp soils at 500 ppm, leading EPA to remove the top six inches of swamp soil and disposing the wastes in an approved offsite hazardous waste facility. The primary contaminants of concern are PCBs. Selected remedies were proposed and are included.

44167 **(PB—87-189932/XAB) Superfund Record of Decision (EPA Region 4): Sapp Battery site, Jackson County, Florida, September 1986. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 26 Sep 1986. 84p. (EPA/ROD/R—04-86/018). NTIS, PC A05/MF A01.

Sapp Battery Service, Inc. began an operation to recover lead from used batteries. The process consisted of breaking open used batteries, dumping the acid outside the plant, recovering the lead, and disposing of the broken battery casings in an onsite manmade fishing pond. In 1977 the acid discharge began killing nearby cypress trees. Soils, sediments, surface water, and ground water contaminated with lead, cadmium, arsenic, antimony and other heavy metals were revealed. The selected remedial action for this site includes: excavation of soils and sediments containing contaminant levels above those set in the Risk Assessment; fixation of the excavated soils/sediments and onsite disposal of the solidified matrix into a cell built to Florida Class I Sanitary Landfill Standards; groundwater removal and treatment of the underlying aquifers; treatment and discharge of contaminated surface water from the onsite swamp and the offsite Steele City Bay area; and monitoring program for potable water wells located within a one-mile radius of the site.

44168 **(PB—87-189940/XAB) Superfund Record of Decision (EPA Region 7): Des Moines TCE, Des Moines, Polk County, Iowa, July 1986. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 21 Jul 1986. 55p. (EPA/ROD/R—07-86/005). NTIS, PC A04/MF A01.

The Des Moines TCE site includes the underground infiltration gallery used by the Des Moines Water Works (DMWW) as a

source of the public water supply. The site was discovered in 1984 after trichloroethylene (TCE) was detected in the city's public water supply. The Dico Company disposed of an unknown quantity of oily waste sludge containing TCE onto their parking lot for dust control and into a drainage ditch on their property. The primary contaminants of concern include: TCE, PCE, 1,2-dichloroethane, vinyl chloride. The selected remedial action for this site includes: extraction wells to collect the contaminated ground water; isolation of the northern-most section of the north gallery; treatment of the ground water through air stripping to remove 96% of the TCE; discharge of the treated water to the Raccoon River; operation of the west extraction wells until established effluent levels are achieved for four consecutive months.

44169 **(PB—87-189973/XAB) Superfund Record of Decision (EPA Region 5): Fields Brook sediment operable unit, Ashtabula, Ohio, September 1986. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 30 Sep 1986. 73p. (EPA/ROD/R—05-86/035). NTIS, PC A04/MF A01.

Fields Brook is located in the City of Ashtabula, Ohio and drains a 5.6-square mile watershed (defined as the 'site'). The 3.5 mile main channel of Fields Brook flows through an industrial area that is one of the largest and most diversified concentrations of chemical plants in Ohio. Industrial sources have contaminated the sediment in Fields Brook with a variety of organic and heavy metal pollutants, including TCE, PCE, chlorobenzene, vinyl chloride, arsenic, zinc, mercury and chromium. Base-neutral compounds including hexachloroethane, toluenediamine and toluene diisocyanate also were detected in Fields Brook sediments. Sediments taken from the Ashtabula River in the vicinity of Fields Brook are contaminated with PCBs. The U.S. EPA believes that the amount of contamination entering the brook at this time has been substantially reduced due to the recent development of pollution control laws and discharge-permitting requirements.

44170 **(PB—87-189999/XAB) Superfund Record of Decision (EPA Region 9): Iron Mountain Mine, Redding, California, October 1986. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 3 Oct 1986. 207p. (EPA/ROD/R—09-86/011). NTIS, PC A10/MF A01.

Iron Mountain Mine (IMM) was periodically mined for iron, silver, gold, copper, zinc, and pyrite. Rainfall, infiltrating into the underground mine workings mixes with ground water and the ore zone to produce sulfuric acid and high concentrations of zinc, cadmium, and copper. The resulting heavy metal-laden acidic waters, referred to as acid mine drainage (AMD), was eventually discharged through mine adits or ground water seepage into the Spring Creek watershed streams, Spring Creek Reservoir, and the Sacramento River. The primary contaminants of concern include: AMD, copper, cadmium, and zinc. The desired remedial action for this site was not selected due to excessive cost. Alternatives were proposed and are detailed in the report.

44171 **(PB—87-190047/XAB) Superfund Record of Decision (EPA Region 2): Vestal Water Supply Well 1-1, Vestal, Broome County, New York, June 1986. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 27 Jun 1986. 51p. (EPA/ROD/R—02-86/026). NTIS, PC A04/MF A01.

The Vestal Water Supply Well 1-1 provides drinking water to several water districts in the Vestal area. In 1978 a chemical spill at the IBM plant in Endicott led to a testing program for all drinking wells in the vicinity for synthetic compounds. Significant concentrations of chlorinated solvents were discovered in well 1-1. Subsequent investigation has since indicated that the presence of chlorinated solvents in the well is not related to the spill at the IBM plant. In late 1982 an investigation implicated, in part, the area around the southeast corner of Stage Road as a suspected source. The primary contaminants of concern include: VOCs, TCE. Selected remedies are proposed and included in the report.

44172 **(PB—87-190062/XAB) Superfund Record of Decision (EPA Region 5): Byron Johnson Salvage Yard, Byron, Illinois, September 1986. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 23 Sep 1986. 62p. (EPA/ROD/R—05-86/042). NTIS, PC A04/MF A01.

The Byron Johnson Salvage Yard located in Ogle County, Illinois contains rubble and domestic refuse, along with industrial wastes including drums and plating materials. Ground water under and downgradient from the site is contaminated with heavy metals, cyanide and Volatile Organic Compounds (VOCs), including TCE and PCE. Because the material within the Salvage Yard has not yet been removed, wastes still present, both on the surface and buried, act as an ongoing source for ground-water contamination. Remedies for cleaning up the site are included in the report.

44173 **(PB—87-190112/XAB) Superfund Record of Decision (EPA Region 2): Caldwell Trucking Company, Township of Fairfield, Essex County, New Jersey, September 1986. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 25 Sep 1986. 63p. (EPA/ROD/R—02-86/029). NTIS, PC A04/MF A01.

The Caldwell Trucking Company site is a 12.2-acre property in Fairfield Township, Essex County, NJ which is bordered by light industry to the north, west, and southwest and is directly across from the Essex County Airport property. For a number of years, Caldwell emptied septic systems and transported the waste to an old slaughter house property (now part of the Caldwell site) for disposal in one of the open, unlined lagoons present on site. The primary contaminants of concern include: VOCs, TCE, PCBs, PAHs, inorganics, and lead.

44174 **(PB—87-190138/XAB) Superfund Record of Decision (EPA Region 2): Syncon Resins Site, Kearny, New Jersey, September 1986. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 29 Sep 1986. 81p. (EPA/ROD/R—02-86/033). NTIS, PC A05/MF A01.

The Syncon Resins site encompasses approximately 15 acres and is located in a heavily industrialized area of northern New Jersey. The Syncon Resin facility produced alkyd resin carriers for pigments, paints, and varnish products. In the production process excess xylene or toluene was separated from the wastewater and reused in subsequent reactions. The remaining wastewater was subsequently pumped to an unlined leaching pond (lagoon) to evaporate or percolate into the soil. The sampling performed during the remedial investigation indicated extensive onsite contamination in the soil, ground water, building dirt/dust, and stainless vessels and tanks. Four general classes of chemical contaminants were found onsite: organic compounds, pesticides, PCBs and metals.

44175 **(PB—87-191870/XAB) Superfund Record of Decision (EPA Region 3): Industrial Lane site--Operable Unit 1, Northampton County, Pennsylvania, September 1986. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 29 Sep 1986. 35p. (EPA/ROD/R—03-86/028). NTIS, PC A03/MF A01.

The Industrial Lane site encompasses approximately two square miles in Williams Township, Northampton County, Pennsylvania. A portion of the Chrin Landfill, a Pennsylvania Department of Environmental Resources permitted landfill, is on the site as are several active and abandoned industrial properties, commercial establishments, railroads and farming/residential areas. As a result of the detection of low-level ground-water contamination, the Chrin Landfill was placed on the NPL in February 1983. In addition to the preparation of a Remedial Investigation, two Feasibility Studies for the Industrial Lane site were also prepared. While residential wells located upgradient of the Chrin Landfill have historically contained only background levels of VOCs, the chemicals detected in wells within the Glendon Boro residential community represent the primary contaminants of concern. These include tetrachloroethene, and chloroform.

44176 **(PB—87-192670/XAB) Development document for interim final effluent limitations, guidelines and proposed new source performance standards for the hospital point-source category.** Hund, F. (Environmental Protection Agency, Washington, DC (USA). Effluent Guidelines Div.). Apr 1976. 134p. (EPA—440/1-76/060N). NTIS, PC A07/MF A01.

The document presents the findings of a study of the hospital point-source category for the purpose of developing effluent

limitations and guidelines for existing point sources, standards of performance for new point sources, and pretreatment standards for new sources, to implement Sections 301 (b), 301 (c), 304 (b), 304 (c), 306 (b), 306 (c) 307 (b), and 307 (c) of the Federal Water Pollution Control Act, as amended (33 U.S.C. 1251, 1311, 1314(b) and (c), 1316(b) and (c), 86 Stat. 816 et. seq.) (the Act).

44177 **(PB—87-202404/XAB) National marine pollution program: summary of federal programs and projects FY 1985 update.** (National Marine Pollution Program Office, Rockville, MD (USA)). Dec 1986. 545p. NTIS, PC A23/MF A01.

See also PB—86-101953.

The National Ocean Pollution Planning Act (NOPPA; P.L. 95-273) requires NOAA to develop a detailed description of Federal research, development, and monitoring efforts related to ocean pollution. The Summary report presents descriptions of 524 projects in 56 programs funded by the 10 Federal departments and independent agencies involved in the National Marine Pollution Program. The update reviews the marine pollution programs undertaken by each of these departments and agencies by describing program goals, objectives, recent accomplishments, future milestones, funding for Fiscal Years 1984 through 1987, and legislative mandates. In addition, the update includes information on Federal personnel, facilities, vessels and other equipment currently assigned to ocean pollution programs.

53 ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

5301 Social And Economic Studies

REFER ALSO TO CITATION(S) 42982, 42984, 42985, 42986, 42992, 43049, 43051, 43401, 44117

44178 **(CONF-8512138—) Environment, economy, society - ways towards a new basic understanding.** Wildenmann, R. (ed.). (Staatsministerium Baden-Wuerttemberg, Stuttgart (Germany, F.R.)). 1986. 420p. (In German). NTIS (US Sales Only), PC A18. File Number DE87752963.

From 4. congress of the Baden-Wuerttemberg government on the future of ecology, economy, and society; Stuttgart, F.R. Germany (17 Dec 1985).

The congress was concerned with the difficult question as to what are the ways and aims of our civilization. It showed that the different individual systems are interlaced and interlinked to an utmost degree, so that the radically simple way of 'either economy or ecology' must definitely be parted with as a fiction. Rather, we must proceed on the tedious path of continuous research, testing, and weighing. Papers relate to the following areas: general discussions - for instance, man and nature, the environment as a scarce resource; ecological problems, for instance, reconciliation of ecology and economy in the farming sector, influence of harmful immissions on long-term silvicultural planning; law issues/order policy, for instance, principles of environmental policy, implementation problems; economic policy/technology, for instance, acceptance of technology, future energy supply by non-polluting power plants; social policy, for instance, development of environmental consciousness, new basic understanding as a consequence of 'guidance by law'. (orig./HSCH).

5302 Assessment Of Energy Technologies

REFER ALSO TO CITATION(S) 43110, 44034, 44035, 44178

55 BIOMEDICAL SCIENCES, BASIC STUDIES

REFER ALSO TO CITATION(S) 44228

44179 **(DOE/MI/10069—T1) Initiation of HBCU [Historically Black Colleges and Universities] collaborative R & D cluster model: Final report.** Bota, K.B. (Atlanta Univ., GA (USA)). 1986. Contract FG05-85MI10069. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013910.

Workshop sessions were conducted in five areas: biological energy, health effects/biology, ecology, physical research, and nuclear medicine. Group reports are presented on various topics in these areas. (DLC)

5502 Biochemistry

REFER ALSO TO CITATION(S) 43680

44180 **(DOE/ER/13352—3) [Controls of the plant endomembrane-secretory pathway]: Performance report.** (Nebraska Univ., Lincoln (USA)). [1987]. Contract FG02-85ER13352. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013295.

This project has been directed towards an understanding of the cellular and molecular mechanisms by which higher plants control the composition of the plasma membrane, through analysis of the biosynthesis, modification and targeting of plasma membrane proteins and glycoproteins. We have undertaken an identification of molecular markers both for the plasma membrane and for the biosynthetic processes, and the development of techniques for the isolation of conditional-lethal mutants defective at defined stages within the endomembrane-secretory pathway responsible for the biosynthesis, modification and targeting of plasma membrane proteins and glycoproteins. For the identification of molecular markers for the plasma membrane, monoclonal antibodies directed against epitopes present at the plant cell surface have been developed. Novel molecular markers for the plant plasma membrane and for the endomembrane-secretory pathway have been sought. Methods for the analysis of beta-glucuronidase in higher plants have been developed. These technologies have involved the use of flow cytometry and fluorescence-activated cell sorting. In addition, we have been investigating the feasibility of expression of animal plasma membrane marker proteins in plants, specifically the VSV G-protein. 5 refs., 6 figs.

44181 **(DOE/ER/60394—T1) The molecular biology of environmental aromatic hydrocarbons: Progress report for the period September 1, 1986 through July 31, 1987.** Weiss, S.B. (Chicago Univ., IL (USA)). Aug 1987. Contract FG02-86ER60394. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013698.

Our laboratory has explored the use of short DNA oligomers as targets for activated polycyclic aromatic hydrocarbons, such as benzo[a]pyrene diol epoxide (BPDE), in order to detect alterations in DNA sequence arrangement. In this model system, oligomers alkylated with (+)-BPDE are ligated into M13 viral DNA and used to transfect Escherichia coli. These cells are plated on agar, incubated at 37°C, progeny viral clones are selected, amplified, and the viral DNAs isolated are sequenced at the site of oligomer insertion. We have devised a procedure for the preparation of unique duplex DNA oligomers such that the site of oligomer alkylation is specific for a single deoxynucleotide species in the two DNA strands. The procedure for oligomer assembly also allows us to vary the position of the alkylated residue in each of the two strands. Using our model system, the results obtained over the past year can be summarized as follows. When nonalkylated oligomer constructs are ligated into M13 viral DNA and used to transfect E. coli, no modifications in DNA sequence arrangement are detected

in progeny viral DNAs. On the other hand, with oligomer constructs containing BP-adducts two major types of modifications in DNA sequence arrangement were observed: (1) large deletions, and (2) nonhomologous (illegitimate) recombinants. Both of these DNA modifications result in the complete removal of the oligomer insert. Transfection of E. coli that are recA$^-$ does not alter these DNA modifications, therefore, it appears that the deletions and recombinants induced by the alkylated inserts are not under control of the RecA gene. As the distance between the alkylated residues in the duplex strands is increased, the number of recombinant events detected is reduced. In addition to the above types of DNA modifications, restoration of the original nucleotide sequence in the alkylated construct was also observed in progeny viral DNAs. 7 refs., 6 figs., 2 tabs.

44182 (IS-T—1311) Laser-based optical activity detection of amino acids and proteins. Reitsma, B.H. (Ames Lab., IA (USA)). Aug 1987. Contract W-7405-ENG-82. 112p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87013600.

The optical activity detector (OAD) for HPLC is a selective detector for optically active substances including amino acids and proteins. Four free amino acids were resolved using cation-exchange chromatography followed by detection with refractive index detector (RI) for proline and threonine and the OAD to an ultraviolet absorbance detector (uv) for tyrosine and phenylalanine. Amino acid detection by refractive index is not sensitive and uv absorbance detects only three amino acids. Derivatization of amino acids to make them detectable by uv absorbance enhances the applicability of OA/uv for the determination of enantiomeric ratios. The separation of 16 dansyl-L-amino acids by RP-HPLC with detection by OA/uv is illustrated. Calculation of the specific rotation of 22 dansyl-L-amino acids shows that derivatization enhances the OA detectability of some amino acids but degrades that of others. RP-HPLC of proteins is a rapidly developing technique. Several researchers have reported the detection of multiple peaks when a pure protein is subjected to HPLC under certain conditions. These multiple peaks have been determined to be different conformations of the same protein. Since proteins are optically active, OA is a suitable detector. The RP-HPLC separation of conformers of soybean trypsin inhibitor is illustrated. Detection by OA/uv provides insights from the chromatogram unavailable from uv absorbance detection alone. In addition, identification of impurities is simplified with OA/uv. Specific rotations of the separated protein fractions show no significant change accompanying change in conformation. 163 refs., 13 figs., 9 tabs.

5503 Cytology

44183 (CONF-8610316—, pp 7.1-7.24) **Silviculture in areas exposed to emission inputs.** Materna, J. 1986. (In German). NTIS (US Sales Only), PC A99. File Number DE87752961.

From CSR symposium and exhibition concerning the planning and protection of the human environment; Duesseldorf, F.R. Germany (1 Oct 1986).

The paper describes the exposure of the Erzgebirge mountain range to air-borne pollutants and the occurring forest injuries. The silvicultural approach adopted for its forests is an extremely careful one: premature interventions may enhance the damage since they may introduce further stress factors or else may be based on a probably wrong damage assessment owing to non-specific characteristics. Soil amelioration, stand liming and additional fertilizing schemes are the methods applied.

44184 Flow cytometric ultrasensitive molecular quantitation via antibody-antigen interactions. Saunders, G.C.; Jett, J.H.; Martin, J.C.; Keller, R.A. (Life Sciences and Chemistry Divisions, Los Alamos Scientific National Lab., Los Alamos, NM 87545). pp MA2.1-MA2.4 of Topical meeting on laser applications to chemical analysis (Technical Digest). Washington, DC; Optical Society of America (1987). (CONF-870119—).

From Topical meeting on laser applications to chemical analysis; Lake Tahoe, NV, USA (26 Jan 1987).

Since the inception of flow cytometry, there has been a continuing quest for more sensitive instruments and for techniques to detect and quantitate low levels of fluorescence. A generally accepted value for the sensitivity of detection of fluorescein on the surface of a cell is 3,000 to 5,000 molecules. Recently, the authors have used flow cytometers to provide the instrumental framework for new types of high sensitivity molecular assays. The techniques developed to date can be divided into two categories: direct solution measurements; and microsphere based assays. By adapting conventional flow cytometers to measure the level of fluorescence from a continuous dye stream, measurements of the number of fluorescent molecules in solution have been made with sensitivities greater than those achieved by any reported technique. The results of these developments are reported in the paper. At Los Alamos, the authors have developed separation free, dual microsphere, flow cytometric competitive binding and sandwich FIA's with detection limits as low as 10/sup -14/ molar. A relatively large (10 μm diameter) non-fluorescent microsphere is used as an antibody carrier, the presence of which in the probe volume of the flow cytometer can be detected by a scattered light measurement.

5504 Genetics

REFER ALSO TO CITATION(S) 44200

44185 (LA-UR—87-1863) Genetic algorithms and classifier systems: Foundations and future directions. Holland, J.H. (Michigan Univ., Ann Arbor (USA)). 1987. Contract W-7405-ENG-36. 17p. (CONF-870775—1). NTIS, PC A02. File Number DE87011793.

From International conference on genetic algorithms and their applications; Cambridge, MA, USA (27 Jul 1987).

Theoretical questions about classifier systems, with rare exceptions, apply equally to other adaptive nonlinear networks (ANNs) such as the connectionist models of cognitive psychology, the immune system, economic systems, ecologies, and genetic systems. This paper discusses pervasive properties of ANNs and the kinds of mathematics relevant to questions about these properties. It discusses relevant functional extensions of the basic classifier system and extensions of the extant mathematical theory. An appendix briefly reviews some of the key theorems about classifier systems. 6 refs.

5505 Metabolism

REFER ALSO TO CITATION(S) 43135, 43166, 44208

5506 Medicine

REFER ALSO TO CITATION(S) 44203

44186 (DOE/EV/10402—T5) Positron ring system using Anger-type detectors: Progress report for period ending December 31, 1987. Muehllehner, G. (Pennsylvania Univ., Philadelphia (USA)). Jun 1987. Contract AC02-80EV10402. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012339.

This report contains a description of the major components of a multislice position scanner and results of performance testing of the device. The principal part of the scanner consists of six NaI scintillation crystals arranged in a hexagonal ring. 50 mm square photomultiplier tubes (PMT's) are arranged in 3 rows of 10 each behind the crystals. A VAX 750 computer processes the signals. Image processing algorithms are discussed. The report concludes with an extensive list of related publications. (JDH)

44187 (INIS-mf—10916) Proceedings of the 14. International cancer congress held at Budapest, Hungary, 21-27 Aug 1986 v. 2, v. 3. Abstracts of lectures, symposia and free communications. Eckhartd, S. (ed.). (International Atomic Energy Agency, Vienna (Austria)). 1986. 901p. (CONF-8608169—Vols.2,3-Absts.). NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596.

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

The volumes contain abbreviated forms or abstracts of lectures and contributions delivered at the 14th International Cancer Congress held between 21-27 August, 1986 in Budapest, Hungary. Altogether, more than 5000 papers were presented. About 250 items falling in the INIS scope are indexed separately. Volumes 2 and 3 contain about 3000 titles with abstracts of the majority of papers.

44188 **Computerized microtomography using synchrotron radiation from the NSLS.** Spanne, P.; Rivers, M.L. (Linkoeping Univ., Sweden; Brookhaven National Lab., Upton, NY; Chicago Univ., IL). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **24/25**: No. 2, 1063-1067(Apr 1987). (CONF-861114—). Contract AC02-76CH00016.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Results of microtomography experiments that employ filtered radiation from the National Synchrotron Light Source X-26 Microprobe beam line are presented. These experiments have yielded images of a freeze-dried caterpillar with a spatial resolution of the order of 30 μm and show that the limit on the spatial resolution with the present apparatus will be 1 to 10 μm. Directions for improvement in synchrotron microtomography techniques and some possible applications are discussed.

44189 **Single molecule detection in fluid solution.** Nguyen, D.C.; Keller, R.A.; Jett, J.H.; Martin, J.C.; Parson, J.D. (Los Alamos National Lab., Los Alamos, NM 87545). pp MA3.1-MA3.4 of Topical meeting on laser applications to chemical analysis (Technical Digest). Washington, DC; Optical Society of America (1987). (CONF-870119—).

From Topical meeting on laser applications to chemical analysis; Lake Tahoe, NV, USA (26 Jan 1987).

The authors are approaching single molecule detection in fluid solution. The author's current limit with dissolved dye molecules is equivalent to the detection of 8 rhodamine-6G fluorophores on a single species. Documentation of this limit is given by the detection of microspheres containing the simulated equivalent of 25 rhodamine-6G fluorophores. The sensitivity of the authors' apparatus will be combined with the specificity of antigen/antibody interactions to provide an analytical technique with the potential for detecting species ranging from chemical agents and high explosives to pathogens in the human body. Dilute Solutions of Rhodamine-6G. Flowing sample streams hydrodynamically focused to a radius of 21 μm are passed through an Ar/sup +/ laser beam focused to a radius of 6 μm. The spatially filtered fluorescence from the interaction region is viewed through a microscope objective to provide a probe volume of 0.6 pl. A detection limit (2σ) of 800 rhodamine 6G molecules during a 1 second counting interval was achieved. This represents greater than an order of magnitude improvement over our previous results. At the detection limit, the probability of a rhodamine 6G molecule being in the probe volume is 0.06. These results translate to the detection of a single species containing the equivalent of 8 rhodamine 6G molecules during the 85 μs transit time of the species across the laser beam.

5507 Microbiology

REFER ALSO TO CITATION(S) 43134, 43135

5510 Physiological Systems

REFER ALSO TO CITATION(S) 44213

5520 Public Health

44190 **(AD-A—180726/2/XAB) Federal emergency management planning. Student essay.** McMullen, J. (Army War Coll., Carlisle Barracks, PA (USA)). 23 Mar 1987. 30p. NTIS, PC A03/MF A01.

Prior to 1978, Federal Emergency Planning had been accomplished by several Federal Civil Agencies. To those who attempted to use the system, the process was described as dismal. There was no central point of departure for Federal emergency management information. Because the Federal Planning System was so bad, President Carter submitted to Congress Reorganization No. 3 of 1978 which consolidated the oversight responsibility for Federal emergency planning into a single agency known as the Federal Emergency Management Agency (FEMA). Consolidated under FEMA were all authorities and functions delegated by law to the President and the Executive for Federal emergency planning. The spectrum of Federal preparedness planning performed by FEMA ranges from a natural disaster to a nuclear attack on the United States. Although constrained by increasing Federal budget deficits and the demand for fiscal soundness, many in FEMA believe that the Agency is prepared to cope with a future that is characterized as complex, and full of uncertainties.

5530 Agriculture And Food Technology

REFER ALSO TO CITATION(S) 44180, 44204

44191 **(CEA-CONF—8688) Practical problems in the transfer of the food irradiation technology from the laboratory to the industry and trade.** Henon, Y. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Service de Radio-Agronomie). Sep 1986. 6p. (CONF-8608174—3). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752217.

From Workshop on economic feasibility of food irradiation applications; Wageningen, Netherlands (25 Aug 1986).

Not all applications of food irradiation developed in laboratories appear feasible at the commercial level. Without taking into account the social and economic factors, some of the obstacles regarding the commodities themselves and some practical aspects of a commercial irradiator are reviewed. The dose distribution found in most facilities make it almost impossible to irradiate products with a narrow dose range tolerance. Treatment of perishable commodities may turn to be difficult, especially in contract facilities, as it is not easy to plan. Similarly, combination of processes will not always be achievable. Applications to products for which the production is both seasonal and scattered do not appear feasible. Some progress is still needed in fields such as, packaging to avoid insect reinfestation after irradiation routine dosimetry and irradiators design.

44192 **(DOE/CH/10288—5) [Radiation induced changes in the cuticular hydrocarbons of the granary weevil and their relationship to desiccation and adult mortality]: Quarterly report, April 1 to June 30, 1987.** (Selma Univ., AL (USA). Div. of Natural and Applied Sciences). 1987. Contract FG02-86CH10288. 3p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013728.

Post-irradiation mortality studies were conducted with different combinations of temperature and humidity on Sitophilus granarius (L.). The epicuticular hydrocarbon composition of granary weevils exposed to gamma radiation was examined.

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

REFER ALSO TO CITATION(S) 44179

5601 Radiation Effects

REFER ALSO TO CITATION(S) 44023, 44025, 44192

44193 **(AD-A—180917/7/XAB) Dithiothreitol elicits epileptiform activity in CA1 of the guinea pig hippocampal slice.** Tolliver, J.M.; Pellmar, T.C. (Armed Forces Radiobiology Research Inst., Bethesda, MD (USA)). 1987. 10p. (AFRRI-SR—87-7). NTIS, PC A02/MF A01.

Pub. in Brain Research, Vol. 404, 133-141(1987).

Dithiothreitol (DTT) is a sulfhydryl reducing agent used as a radioprotectant. Exposure of hippocampal slices, for 30 min to 0.5 micromoles DTT irreversibly increased the orthodromic population

spike amplitude, promoted repetitive firing and induced spontaneous epileptiform activity in the CA1 subfield. The same concentration of the oxidized form of DTT did not increase hippocampal excitability. Although the slope of the population synaptic response to afferent stimulation (popPSP) was unchanged by DTT, the duration of the popPSP was prolonged. Recurrent inhibition was unaffected. DTT probably exerts its effects through an irreversible chemical reaction with cellular components. Possible mechanisms of DTT-induced epileptiform activity are discussed.

44194 **(AD-A—180962/3/XAB) Modification by WR2721 of acute and chronic effects of radiation injury to the lung. Annual report, February 1, 1984-August 31, 1985. Final report, September 1982-31 August 1985.** Thet, L.A. (Duke Univ., Durham, NC (USA). Medical Center). Sep 1985. 43p. NTIS, PC A03/MF A01.

Quantitative ultrastructural techniques were used to (1) study the effectiveness of WR27221 in protecting rat lung cells and tissues against radiation injury (2) test whether the protective effect of WR2721 could be enhanced by glucocorticoids. Four groups were studied: control rats, rats in which the left lung was irradiated with a single dose of 3000 rads, radiated rats injects with a 400 mg/kg intraperitoneal dose of WR2721 thirty minutes before radiation, and radiated rats which received both WR2721 and 12 weeks of glucocorticoid administration. All four groups were studied at 12, 26, and 52 weeks post-radiation; it was conclude that after a single dose of 3000 rads, WR2721 provided no protection at 12 weeks, modest protection at 26 weeks, and substantial protection at 52-week post-radiation. Addition of glucocorticoids significantly enhanced the protective effects of WR2721. These effects first became manifest only between 12 and 26 weeks i.e., after glucocorticoid therapy ended. The mechanism of these effects is not known but is possibly due to relative preservation of the ability of lung cells to interact with each other to (i) inhibit fibroblast proliferation and collagen synthesis or (ii) remodel fibrotic lung tissues.

44195 **(AD-A—181044/9/XAB) Effect of radiation dose on the recovery of aerobic and anaerobic bacteria from mice.** Brook, I.; Walker, R.I.; MacVittie, T.J. (Armed Forces Radiobiology Research Inst., Bethesda, MD (USA)). 1986. 5p. (AFRRI-SR—87-1). NTIS, PC A02/MF A01.

Pub in Canadian Jnl. Microbiology, Vol. 32, 719-722(1986).

The presence of aerobic and anaerobic bacteria in the blood, spleen, and liver was investigated in mice that were exposed to 7, 8, 9, or 10 Gy ^{60}Co radiation. Microorganisms were detected more often in animals exposed to higher doses of radiation. The number of mice that were culture positive and the number of isolates in one site increased with increasing dose. Bacteria were recovered in mice killed at various times after radiation, in 3 of 100 mice exposed to 7 Gy, in 13 of 100 irradiated with 8 Gy, in 23 of 90 exposed to 9 Gy, and in 34 of 87 irradiated with 10 Gy. The predominant organisms recovered were Escherichia coli, anerobic Gram-positive cocci, Proteus mirabilis, Staphylococcus aureus, and Bacteroides spp. Escherichia coli and anaerobes were more often isolated in animals exposed to 10 Gy, while S. aureus was more often recovered in those irradiated with 9 Gy. These data demonstrate a relationship between the dose of radiation and the rate of infection due to entire aerobic and anaerobic bacteria. Reprints.

44196 **(AD-A—181045/6/XAB) Cytokines in radioprotection. Comparison of the radioprotective effects of IL-1 to IL-2, GM-CSF and IFN gamma.** Neta, R.; Vogel, S.N.; Oppenheim, J.J.; Douches, S.D. (Armed Forces Radiobiology Research Inst., Bethesda, MD (USA)). 1986. 7p. (AFRRI-SR—87-6). NTIS, PC A02/MF A01.

Pub in Lymphokine Research, Vol. 5, Supplement 1, S105-S110(1986).

Immunomodulatory agents are radioprotective when administered to animals prior to irradiation. The mechanisms for this radioprotection have as yet not been determined, but may involve endogenously released cytokines. The authors demonstrated that murine IL-1 is radioprotective in mice (Neta et al., J. Immunol.,136, 2483, 1986). In this study they further explored this effect and investigated whether the radioprotective effest of IL-1 is mediated by other cytokines. Optimal radioprotection with IL-1 was obtained with administration 20 hr prior to irradiation and was greatly reduced with administration 45 or 4 hr before or 1 hr after irradiation with 950 cGY, and LD50/30 was an LD100/30 dose. The dose reduction factor (DRF) measured by LD50/30 was 1.25 for C57B1/6 mice. The presence of lag periods in IL-1 induced radioprotection suggests that the effect of IL-1 may be indirect.

44197 **(AD-A—181082/9/XAB) Radioprotection by interleukin. 1.** Neta, R.; Douches, S.D.; Oppenheim, J.J. (Armed Forces Radiobiology Research Inst., Bethesda, MD (USA)). 1987. 14p. (AFRRI-SR—87-5). NTIS, PC A02/MF A01.

Pub. in Immune Regulation by Characterized Polypeptides, 429-441(1987).

Protection from lethal effects of ionizing radiation has been achieved by administration prior to irradiation of immunomodulatory substances. The mechanism of radioprotection by immunomodulators is unknown. Since immunomodulatory substances induce the release of cytokines we studied two of the cytokines, IL-1 and IL-2 for their radioprotective effect. Administration of IL-1 protects mice in a dose-dependent manner from lethal effect of ionizing radiation. The IL-1 conferred radioprotection is time dependent with administration 20 hrs prior to radiation yielding optimal effect. Administration of IL-2 did not have a significant radioprotective effect.

44198 **(BNL—39930) Review of radial dose profiles for heavy ions.** Varma, M.N.; Baum, J.W. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 5p. (CONF-870779—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012114.

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

Average energy deposited per unit mass in a cylindrical shell formed between radial distance r and r + dr from the trajectory of incident ions is defined as the radial dose D(r). Variation of D(r) as a function of radial distance is the radial dose profile. This radial dose profile information has been used by others to develop biophysical models of radiation effects. Radial dose profiles for heavy ions also provide data that can be checked against calculations made by different track structure codes based on continuous slowing down models or Monte Carlo methods. In addition radial dose profiles can also be determined from measured event size distributions. By comparing radial dose from two different experimental techniques, a direct evaluation of different experimental procedures and methods can be made. In this document we review the experimental measurement technique for determination of radial dose profiles, and the experimental data available for different heavy ions at different energies. 15 refs., 5 figs.

44199 **(CONF-870163—2) Mechanisms of radiation interaction with DNA: Potential implications for radiation protection.** Sinclair, W.K.; Fry, R.J.M. (Oak Ridge National Lab., TN (USA); National Council on Radiation Protection and Measurements, Bethesda, MD (USA)). 1987. Contract AC05-84OR21400. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012536.

From DOE/CEC workshop on mechanisms of radiation interaction with DNA; San Diego, CA, USA (21 Jan 1987).

An overview of presentations and discussions which took place at the US Department of Energy/Commission of European Communities (DOE/CEC) workshop on "Mechanisms of Radiation Interaction with DNA: Potential Implications for Radiation Protection," held at San Diego, California, January 21-22, 1987, is provided. The Department has traditionally supported fundamental research on interactions of ionizing radiation with different biological systems and at all levels of biological organization. The aim of this workshop was to review the base of knowledge in the area of mechanisms of radiation action at the DNA level, and to explore ways in which this information can be applied to the development of scientifically sound concepts and procedures for use in the field of radiation protection.

44200 **(DOE/ER/60393—2) Mutagenic effect of tritium on DNA of Drosophila melanogaster: Technical progress report, December 15, 1986-July 15, 1987.** Lee, W.R. (Louisiana State Univ., Baton Rouge (USA). Dept. of Zoology and Physiology). [1987]. Contract FG05-86ER60393. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013456.

Recombinant DNA techniques were used to analyze mutants induced by either tritium or x-ray. Mutations induced at the alcohol dehydrogenase locus (Adh) in Drosophila melanogaster were first characterized by genetic complementation tests to determine if a multi-locus deletion has occurred. Mutants that are intragenic as defined by the complementation test are then placed opposite a deficiency so that the DNA from the mutant allele may be extracted and analyzed. Part I of the project is to analyze mutants induced by ionizing radiation with molecular techniques, and part II is to determine the molecular effects of these mutant phenotypes on their expression in the polypeptide produced by the mutant gene. Part III of this project consists of inducing mutants with tritiated water at the Adh locus in D. melanogaster. We have reported the development of a feeding method for exposing male D. melanogaster to tritiated water that would give a range in dose from 6.66 Gy to 26.64 Gy. This method of exposing Drosophila was used first to study a dose response curve for tritium using as a genetic endpoint the sex-linked recessive lethal test. 3 figs., 1 tab.

44201 **(DOE/ER/60452—1) Lung cancer epidemiology in New Mexico uranium miners: First annual progress report for the period 1 July 1986-31 March 1987.** Samet, J.M. (New Mexico Univ., Albuquerque (USA)). Apr 1987. Contract FG04-86ER60452. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013517.

This Technical Progress Report covers the initial nine months of work performed under contract DE-FG04-86ER60452, "Lung Cancer Epidemiology in New Mexico Uranium Miners." This contract extends support for a project previously funded for a three year period under contract DE-AS04-83ER60119. The principal project funded by the contract is a retrospective cohort study of underground uranium miners who had completed at least one month of underground experience by the end of 1971. During the first nine months of the new contract, we have continued to assemble exposure histories by simultaneous review of information from personnel records, exposure reports, self-reported mining histories, and the data assembled by NIOSH for the Colorado Plateau Study. We are also conducting a case control study within the cohort; for the 69 lung cancer cases incident in Hispanic and non-Hispanic whites, four controls have been selected. Preliminary analyses have been performed and analytical techniques developed. Additional follow-up of the cohort is also in progress. 1 fig., 1 tab.

44202 **(HEHF—54-86) United States Transuranium Registry: Annual report, October 1, 1985 through September 30, 1986.** Swint, M.J.; Kathren, R.L. (Hanford Environmental Health Foundation, Richland, WA (USA)). Jun 1987. Contract AC06-65RL01837. 39p. NTIS (US Sales Only), PC A03/MF A01; 1; GPO Dep. File Number DE87012815.

This report describes the activities of the US Transuranium Registry including as an appendix the observations and recommendations of the Advisory Committee. Highlights include a reduction of the number of routine autopsy registrants by 6% to 609, in consonance with increased cost effective operations; an international analytical laboratory intercomparison for plutonium quantitation in human lung and liver in cooperation with the National Bureau of Standards; a study of the partial body autopsy results which indicated that the initial deposition of Am-241 in the skeleton is greater than plutonium and that deposition of Pu-238 may be greater than that of Pu-239; a comparison of plutonium deposition in 17 selected cases; a comparison of four methods for separating bone marrow from mineralized bone indicated the marrow contained about 4% of the total plutonium in the skeleton; an evaluation of actinide distribution in four human half-skeletons indicated plutonium and americium distributions were remarkably consistent; and the preparation of in-vivo counting standards from a USTR whole body include a skull (complete), arm, leg, and torso phantoms.

44203 **(INIS-mf—10937) European Society for Radiaton Biology - 19th annual meeting. Abstracts.** (Ceska Lekarska Spolecnost J.E. Purkyne, Prague (Czechoslovakia). Spolecnost Nuklearni Mediciny a Radiacni Hygieny). 20 Feb 1986. 373p. (CONF-8508212—Absts.). NTIS (US Sales Only), PC A16/MF A01. File Number DE87702598.

From 19. annual meeting of the European Society for Radiation Biology; Prague, Czechoslovakia (26 Aug 1985).

The proceedings contain 313 abstracts of papers. The topics covered include: biological radiation effects on lipids, hormones, fibroblasts, on bone healing, DNA repair, DNA synthesis, tumor cells, giant cell formation, on the lymphatic system, central nervous system and the hematopoietic system; determination of RBE; radioprotective agents; radiotherapy; dosimetry; radiation induced mutations; oxygen effects; radiosensitivity of tumor cells; hyperthermia and hypoxia effects on radiosensitivity; biological radiation effects on the growth of plants. (J.P.).

5603 Chemicals Metabolism And Toxicology

REFER ALSO TO CITATION(S) 43208, 43972, 43979, 43982, 43995, 44119, 44149, 44181

44204 **(DOE/BP/11888—3) Development of rations for the enhanced survival of salmon: Annual report 1986.** Crawford, D.L.; Schreck, C.B.; Bradford, S.; Lorz, H.; Ewing, R.D.; Westgate, J.; Lagasse, J.P. (Oregon State Univ., Astoria (USA). Seafoods Lab.; Oregon State Univ., Corvallis (USA). Oregon Cooperative Fisheries Research Unit; Oregon Dept. of Fish and Wildlife, Corvallis (USA); Oregon Dept. of Fish and Wildlife, Clackamas, OR (USA); Oregon Dept. of Fish and Wildlife, Sandy (USA)). Aug 1987. Contract AI79-83BP11888. 49p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013982.

This investigation tests the hypothesis that ration protein quality can influence the survival of smolts and the ultimate return of adults. The general approach being used involves a comparison of coho and chinook salmon reared on rations containing very high quality protein derived from vacuum dried meals and commercial rations relying on commercial fish meal as a source of protein. Survival and return of replicate brood-years of coded wire tagged test and control fish are being used to determine the influence of ration on survival. Project rearing and release of tagged fish to date include 1982, 1983, and 1984-brood replicates of coho salmon; the 1983 and 1984-brood replicates of fall chinook (tule stock salmon; and the 1985-brood of fall chinook (up-river-bright stock) salmon. The 1985-brood year replicate of coho salmon is presently being reared and has been tagged for release in April 1987. The rearing of the 1986-brood replicate of fall chinook (up-river-bright stock) salmon has been initiated. This report covers the rearing and release of the 1984-brood coho and the 1985-brood fall chinook (up-river-bright stock) salmon. Plasma cortisol and thyroxine (T_4) level, gill Na^+/K^+-ATPase, osmoregulatory performance, immunocompetency and total hepatic/gill microsomal lipid content were monitored from early June to mid-October 1986 to assess the physiological condition of fall chinook salmon. Results indicated that on several sampling dates early in the 1986 rearing period fish supplied the control ration were physiologically different than fish receiving the salmon meal ration. Incomplete recovery of coded wire tags from 1982 and 1983-broods of coho salmon (Sandy stock) revealed an improved ($P \geqq .05$) survival for fish supplied test rations.

44205 **(PB—87-191615/XAB) Human exposure to mutagens from indoor combustion sources.** Lewtas, J.; Claxton, L.D.; Mumford, J.L. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). May 1987. 9p. (EPA—600/D-87/144). NTIS, PC A02/MF A01.

The authors measured human exposure to mutagens, using indoor medium-volume samplers and personal samplers, in targeted field studies of homes in the U.S. The combustion sources included in these studies were woodstoves, fireplaces, gas appliances, cooking, and tobacco smoking. These studies demonstrate that the presence of environmental tobacco smoke (ETS) consistently results in human exposure to mutagens which are significantly higher than outdoor air or non-smoking indoor spaces. The mutagenic emission rates from the other indoor combustion sources (e.g., kerosene heaters) as determined in chamber studies are more variable than ETS and are dependent on the combustion source design and operation. Woodstoves and fireplaces result in higher concentrations of mutagens outdoors, which may indirectly influence the concentration of mutagens indoors.

44206 **(PB—87-196499/XAB) Effect of hygroscopic growth upon the regional dispersion of particulates in human airways.** Martonen, T.B.; Graham, R.C. (Northrop Services, Inc., Research Triangle Park, NC (USA)). May 1987. 17p. NTIS, PC A02/MF A01.

To improve aerosol therapy regimens or to assess the health hazards of inhaled toxic particulates, the dose delivered to the human respiratory tract must be determined. The efficiency with which an aerosol is deposited in various compartments of the tract is a function of its mass median aerodynamic diameter, MMAD (Task Group on Lung Dynamics, 1966). If an airborne particle is hygroscopic, it will change in geometric diameter and density as a result of water vapor uptake; its MMAD, therefore, will vary with location throughout the human respiratory tract. As a result, its dose distribution will differ from that for a nonhygroscopic (i.e., hydrophobic) aerosol of identical inhaled MMAD.

44207 **(PB—87-203055/XAB) Dose-response functions for effects of acidic precipitation on vegetation.** Jacobson, J.S.; Troiano, J.J. (Boyce Thompson Inst. for Plant Research, Ithaca, NY (USA)). 1983. 8p. NTIS, PC A02/MF A01.

Pub. in Water Quality Bulletin 8(2) 67-71, 109(1983).

Contamination of the atmosphere by gaseous, liquid, and solid components generated by anthropogenic emissions has been known for more than a century. Some of these pollutants, namely ozone (O_3) and sulfur dioxide (SO_2), are known to affect the growth, development, and yield of crops. The purpose of the article is to describe some aspects of the phytotoxicity of acidic precipitation and to propose some improvements in experimental approaches in order to develop accurate dose-response functions.

44208 (SRO—819-17, pp 68-72) **Use of multiple stable isotope: to discriminate among sources of allochthonous organic material.** McArthur, J.V.; Scott, M.L. Sep 1986. NTIS, PC A09/MF A01. File Number DE87012054.

In Ecological research at the Savannah River Ecology Laboratory: Annual report for the period ending July 31, 1986.

Although stable isotopes effectively resolve differences among broad categories of organic matter (e.g., between C-3 and C-4 plants), use of multiple stable isotopes to discriminate among organic matter sources within such categories has not been reported. In this study the authors show that stable isotopes ^{13}C, ^{34}S, and ^{15}N) can be used to discriminate among sources of allochthonous organic matter from a group of C-3 plants that form the dominant riparian vegetation of many coastal plain streams in the southeastern US. This information may link sources of allochthonous plant material to freshwater aquatic food webs. 3 figures, 1 table.

44209 (SRO—819-17, pp 78-82) **Size-dependent pharmacokinetics of trace element accumulation by Gambusia affinis with emphasis on zinc.** Newman, M.C.; Mitz, S.V. Sep 1986. NTIS, PC A09/MF A01. File Number DE87012054.

In Ecological research at the Savannah River Ecology Laboratory: Annual report for the period ending July 31, 1986.

The purpose of the present study was to develop an animal model to test the following hypotheses: (1) Linking to size-dependent metabolic rate can be implied for relationships with b-values of less than 1 as the b-value is the same as the b-value for the size-dependent metabolic rate relationship (Boyden's untested hypothesis), and (2) if the implied linkage between size-dependent metabolic rate and size-dependent body burden is not correct then a simple pharmacokinetic model can produce a size-dependent body burden relationship with a b-value of less than one. 4 figures, 1 table.

44210 **(UCID—20931) Smokes and obscurants: A health and environmental effects data base assessment: A first-order, environmental screening and ranking of Army smokes and obscurants: Phase 1 report.** Shinn, J.H.; Martins, S.A.; Cederwall, P.L.; Gratt, L.B. (Lawrence Livermore National Lab., CA (USA); IWG Corp., San Diego, CA (USA)). Mar 1985. Contract W-7405-ENG-48. 119p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87013834.

An initial environmental screening and ranking is provided for each Army smoke and obscurant (S and O) depending on smoke type and smoke-generating device. This was done according to the magnitude of the impact area, the characteristic environmental concentration, the relative inhalation toxicity, the relative toxicity when ingested by animals, the aquatic toxicity, the environmental mobility when freshly deposited, and the ultimate mobility and fate in the environment. The major smoke types considered were various forms of white phosphorus (WP), red phosphorus (RP), hexachloroethane-derived smokes (HC), fog oil (SGF-2), diesel fuel smokes (DF), and some infrared obscuring agents (IR).

44211 **Biological dosimetry of mutagenesis: Principles, methods, and cytometric prospects.** Mendelson, M.L. (Lawrence Livermore National Lab., Biomedical Sciences Div., Univ. of California, P.O. Box 5507 L-452, Livermore, CA 94550). pp 141-148 of Biological dosimetry: Cytometric approaches to mammalian systems. Eisert, W.G.; Mendelson, M.L. New York, NY; Springer-Verlag New York Inc. (1984). Contract W-7405-ENG-48.

Society needs three kinds of information about mutagenesis: screening information for identification of mutagenic agents; mammalian and human dosimetric information for species extrapolation, hazard analysis and identification of hypersensitive individuals; and sufficient knowledge of mechanism to understand the consequences of mutation, to evaluate risk, and to make the appropriate short- and long-term regulatory decisions. Thousands of chemical mutagens have been identified in the screening process, even though only a small fraction of chemicals have yet to be tested. Potency and issues of specie and individuals-within-specie differences in sensitivity are poorly understood.

5604 Other Environmental Pollutant Effects

44212 **(AD-A—180678/5/XAB) Radiofrequency radiation dosimetry handbook. 4th edition. Final report, 1 July 1984-31 December 1985.** Durney, C.H.; Massoudi, H.; Iskander, M.F. (Utah Univ., Salt Lake City (USA). Dept. of Electrical Engineering). Oct 1986. 509p. NTIS, PC A22/MF A01.

Supersedes rept. nos. AD—A030 874; AD—A058 480, and AD—A089 915.

The purpose of this fourth edition is to provide a convenient compilation of information contained in the previous editions, including updated tables of published data, and to add new information. Chapter 2 contains information about how to use this handbook. Chapter 3 contains a discussion of the basics of electromagnetics for readers who are not physicists or engineers. Chapter 4 gives information about permittivities and contains an updated compilation of the summaries of published data from previous editions. Theoretical dosimetry is discussed in Chapter 5, including a brief discussion of methods used for dosimetric calculations, data for models of biological systems, and a tabulated summary of published work in theoretical dosimetry. The calculated dosimetric data in Chapter 6 contains, in addition to material from previous editions, some new calculated average-SAR data for spheroidal models at frequencies well beyond resonance. These calculations were made by spheroidal models at frequencies well beyond resonance. These calculations were made by a new technique called the iterative extended boundary conditions method (IEBCM), which was developed at the University of Utah after the third edition was published. Chapter 6 also contains some new calculated average-SAR data for spheroidal models irradiated by near fields. Chapter 7 contains information about experimental dosimetry, including a history of experimental dosimetry and a discussion of experimental techniques.

44213 **(AD-A—180776/7/XAB) Impulse noise hazard as a function of level and spectral distribution. Final report.** Price, G.R. (Army Human Engineering Labs., Aberdeen Proving Ground, MD (USA)). 1986. 18p. (HEL-TM—3-87). NTIS, PC A02/MF A01.

Pub. in Basic and Applied Aspects of Noise-Induced Hearing Loss, 379-392(1986).

Data are presented from a series of experiments on hearing loss from weapons impulses in which cat ears were exposed to weapons impulses and tested electrophysiologically. Hazard increases as the spectral peak moves upward from about 100 Hz (large caliber weapon) toward the mid-range (3.0 kHz.). These data

are consistent with the content that there is a spectrally dependent critical level at which loss processes become reversible to only a limited degree and permanent changes in the ear result. Furthermore, none of the existing damage-risk criteria in use in the world assesses hazard in a manner consistent with these data.

44214 **(AD-P—005267/0/XAB) Safety issues concerning diode lasers used in telecommunications systems.** Petersen, R.C.; Philen, D.L. (AT and T Bell Labs., Murray Hill, NJ (USA)). Nov 1986. 7p. NTIS, PC A02/MF A01.

This article is from Proceedings of the International Wire and Cable Symposium (35th) Held in Reno, Nevada on 18-20 November 1986, AD-A180 828, 426-433.

A theoretical analysis of the potential risk for eye injury resulting from exposure to a severed lightguide cable is discussed. Biological data was collected that confirms the results of the theoretical study. The conclusion from these studies is that inadvertent viewing of the end of a severed optical fiber cable will not result in injury to the eye. The exposure levels are much lower than the maximum permissible exposure levels recommended by ANSI.

44215 **(PB—87-198859/XAB) Lethal and sublethal effects of the water-soluble fraction of Cook Inlet crude oil on Pacific herring (Clupea harengus pallasi) reproduction. Technical memo.** Rice, S.D.; Babcock, M.M.; Brodersen, C.C.; Carls, M.G.; Gharrett, J.A. (National Marine Fisheries Service, Auke Bay, AK (USA). Auke Bay Lab.). Feb 1987. 68p. (NOAA-TM-NMFS-F/NWC—111). NTIS, PC A04/MF A01.

The objectives of the study was to determine the median concentration of Cook Inlet crude oil Water Soluble Fraction that would kill 50% of prespawning adult Pacific herring exposed (LC50); the uptake and depuration of aromatic hydrocarbons in gonads, liver, and muscle of mature herring.

58 GEOSCIENCES

REFER ALSO TO CITATION(S) 42981, 44228

5801 Geology And Hydrology

REFER ALSO TO CITATION(S) 43077, 43097, 44450

44216 **(DOE/ER—0320) Microbiology of subsurface environments: Deep Probe sampling design and planning workshop.** Wobber, F.J.; Zachara, J.M. (USDOE Office of Energy Research, Washington, DC. Ecological Research Div.; Pacific Northwest Lab., Richland, WA (USA)). 1987. 33p. (CONF-8702102—Summ.). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012324.

From Deep probe sampling design and planning workshop; Augusta, GA, USA (17 Feb 1987).

This report describes the results of an invited workshop in support of DOE's microbiology research program (Deep Probe). This report summarizes the major recommendations of the workshop, and contains DOE's perspectives on tasks related to the following areas: drilling and coring procedures; tracer technologies and issues of contamination; supplementary geohydrological, sedimentological and geological analysis relevant to analysis of deep microbial habitats; statistical analysis of existing samples; experimental design for future coring; improvements in microbiological sampling, core handling, and acquisition of pore water chemical samples; interlaboratory standardization of microbiological protocols; DOE's strategy for extension of the research to other hydrogeological regimes; and, accelerated information exchange with the scientific community.

44217 **(DOE/ER/13013—4) Investigations of the thermal evolution of sedimentary basins using $^{40}Ar/^{39}Ar$ thermochronology: Applications to petroleum exploration: Final report, September 1, 1982 to March 31, 1987.** Harrison, T.M. (State Univ. of New York, Albany (USA). Dept. of Geological Sciences). Jul 1987. Contract AC02-82ER13013. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012092.

Our work has demonstrated the potential of $^{40}Ar/^{39}Ar$ age spectrum analysis of detrital microclines in revealing thermochronological information. By irradiating feldspars with a known dose of fast neutrons, and isotopically distinct but chemically identical form of the daughter (^{39}Ar) is produced from potassium, making the $^{40}Ar/^{39}Ar$ ratio of a geological sample implicitly proportional to age. If the sample has experienced heating in the temperature range $\sim 100^{\circ}$ to $200^{\circ}C$ for geological time, the transport kinetics of ^{40}Ar in microcline are sufficiently rapid to cause partial outgassing of the sample which can be revealed during analysis. Given that we can obtain sample intensive diffusion parameters as a by-product of the experiment, a partially outgassed K-spar can yield information related to both the ages of crystallization and reheating as well as the temperature of the heating event. Detrital microcline separates analyzed from deep drill cores from a variety of basins yield encouraging results and demonstrate the utility of this approach - especially when combined with results from apatite fission track analyses. In summary, $^{40}Ar/^{39}Ar$ analysis of detrital microcline crystals can yield thermochronologic information in the temperature-time range of petroleum maturation and provides this technique with potential, as both a useful exploration tool, and as a means of probing the fundamental geodynamic processes of sedimentary basin evolution.

44218 **(DOE/ID/12526—T4) Geologic map of the Crescent Mountain Area, Linn County, Oregon.** Black, G.L. (Oregon State Dept. of Geology and Mineral Industries, Portland (USA)). 1987. Contract FG07-84ID12526. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013081.

This map and accompanying table show the geology of the Crescent Mountain area. Lithologic units are described and chemical composition given for selected samples. (ACR)

44219 **(DOE/ID/12526—T5) Field geology of the northwest quarter of the Broken Top 15′ quadrangle, Deschutes County, Oregon.** Taylor, E.M. (Oregon State Dept. of Geology and Mineral Industries, Portland (USA)). 1987. Contract FG07-84ID12526. 49p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013079.

The report is a compilation of geologic field observations and supporting laboratory data obtained during a study of the eastern slope of the High Cascade Range of Oregon, north of Broken Top volcano. General geologic relationships are summarized, then followed by lithologic descriptions, petrographic characteristics, and stratigraphic information, cross-indexed to tables of chemical analyses of pertinent rock units. The 7.5-minute N.W. Broken Top quadrange is bounded by 44°07′30″ and 44°15′00″ north latitude and by 121°37′30″ and 121°45′00″ west longitude, 6 km east of North and Middle Sister volcanoes and 35 km northwest of Bend. The quadrangle is covered by glacial till and calc-alkaline lavas, most of which originated on the adjacent slopes of the High Cascades. Basalt, basaltic andesite, andesite, and rhyodacite are represented in a variety of forms including lava flows, volcanic domes, cinder cones, and a welded ash-flow tuff.

44220 **(DOE/NV/10384—16) A deuterium-calibrated groundwater flow model of the western Nevada Test Site and vicinity.** Feeney, T.A.; Campana, M.E.; Jacobson, R.L. (Nevada Univ., Reno (USA). Desert Research Inst.). May 1987. Contract AC08-85NV10384. 56p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87012986.

A discrete-state compartment model, consisting of nine aquifer sub-regions, is calibrated with the stable isotope deuterium to delineate groundwater flow in the vicinity of western Nevada Test Site. Calibrated deuterium concentrations agree very closely with observed ones, except on eastern Pahute Mesa and Timber Mountain (which had no data on observed deuterium concentrations). Model flow paths and amounts are in relative agreement with previous studies. The total groundwater flow through the modeled area is 32.4×10^6 m^3/yr. Fortymile Canyon/Wash and Pahute Mesa are major recharge sites, accounting for 2.6 and 8.1×10^6 m^3/yr of recharge, respectively. Recharge, as a percentage of precipitation, is greatest in Fortymile and Stockade Washes, ranging between 5 and 12 percent. In Crater Flat, Timber Mountain, and eastern Pahute Mesa, recharge is between 1 and 2 percent of precipitation.

Major discharge areas occur in Oasis Valley and the Amargosa Desert, discharging 2.7 and 28.8 x 10^6 m^3/yr, respectively. Groundwater mean ages range from 2700 years at Ash Meadows to 9200 years at Pahute Mesa, and represent minimum groundwater residence times. The reason these ages are "minimums" stems from the inability of the current DSC computer code to assign non-zero ages to underflow recharge amounts when in reality these waters may be many thousands of years old. Research is underway to circumvent this drawback. The DSC deuterium model has not been verified, primarily because it is quite different from conventional groundwater flow models; hence, comparisons are difficult. 34 refs., 6 figs., 7 tabs.

44221 (LA-UR—87-1526) Hydrologic modeling of soil water storage in landfill cover systems. Barnes, F.J.; Rodgers, J.C. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 11p. (CONF-870758—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010104.

From International conference on measurement of soil and plant water status; Logan, UT, USA (6 Jul 1987).

The accuracy of modeling soil water storage by two hydrologic models, CREAMS and HELP, was tested by comparing simulation results with field measurements of soil moisture in eight experimental landfill cover systems having a range of well-defined soil profiles and vegetative covers. Regression analysis showed that CREAMS generally represented soil moisture more accurately than HELP simulations. Soil profiles that more closely resembled natural agricultural soils were more accurately modeled than highly artificial layered soil profiles. Precautions for determining parameter values for model input and for interpreting simulation results are discussed.

44222 (LBL—23464) Some recent developments in understanding the hydrology of fractured rocks. Witherspoon, P.A.; Long, J.C.S. (Lawrence Berkeley Lab., CA (USA)). Apr 1987. Contract AC03-76SF00098. 14p. (CONF-870625—15). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011102.

From 28. U.S. symposium on rock mechanics; Tucson, AZ, USA (29 Jun 1987).

Current research on fracture hydrology at Lawrence Berkeley Laboratory is focused on two scales: the single fracture and fracture networks. In the area of single fractures, we have established a research program aimed at characterizing the geometry of the void spaces. This involves the use of metal casts and mercury injection to elucidate details of the complex geometry that result as a fracture closes under stress. With this geometry, the flow regime is being examined using an approach based on Navier-Stokes equations. Three techniques are being used to investigate the geometry of fracture networks: (1) statistical analysis of observed field data, (2) geophysical techniques for seeing into the rock, and (3) prediction of fracture patterns through the application of rock mechanics. Statistical analysis has centered on developing a parent-daughter model to represent fracture swarms. Techniques for comparing the results of seismic tomography with the fracture properties controlling flow are being investigated. Shear zones have become a major focus of our efforts because they appear to control the hydrology of many sites. New models for fluid flow include the development of codes to analyze flow and transport in a network of channelized fractures.

44223 (USGS/MAP/I—1728) Late Tertiary and Quaternary geology of the Tecopa basin, southeastern California. Hillhouse, J.W. (Geological Survey, Reston, VA (USA)). 1987. Contract AI08-78ET44802. 28p. US Geological Survey, Open File Service, Box 25425, Denver Federal Center, Denver, CO 80225. File Number TI87013514.

Stratigraphic units in the Tecopa basin, located in southeastern California, provide a framework for interpreting Quaternary climatic change and tectonism along the present Amargosa River. During the late Pliocene and early Pleistocene, a climate that was appreciably wetter than today's sustained a moderately deep lake in the Tecopa basin. Deposits associated with Lake Tecopa consists of lacustrine mudstone, conglomerate, volcanic ash, and shoreline accumulations of tufa. Age control within the lake deposits is provided by air-fall tephra that are correlated with two ash falls from the Yellowstone caldera and one from the Long Valley caldera. Lake Tecopa occupied a closed basin during the latter part, if not all, of its 2.5-million-year history. Sometime after 0.5 m.y. ago, the lake developed an outlet across Tertiary fanglomerates of the China Ranch Beds leading to the development of a deep canyon at the south end of the basin and establishing a hydrologic link between the northern Amargosa basins and Death Valley. After a period of rapid erosion, the remaining lake beds were covered by alluvial fans that coalesced to form a pediment in the central part of the basin. Holocene deposits consist of unconsolidated sand and gravel in the Amargosa River bed and its deeply incised tributaries, a small playa near Tecopa, alluvial fans without pavements, and small sand dunes. The pavement-capped fan remnants and the Holocene deposits are not faulted or tilted significantly, although basins to the west, such as Death Valley, were tectonically active during the Quaternary. Subsidence of the western basins strongly influenced late Quaternary rates of deposition and erosion in the Tecopa basin.

5802 Geophysics

REFER ALSO TO CITATION(S) 43100, 43712, 43954, 43959

44224 (AD-A—180823/7/XAB) Soil-structure interaction during earthquakes: centrifuge model studies and computer analysis. Final technical report. Finn, W.D. (Cork Geotechnics Ltd., Castlemartyr (Ireland)). 30 Apr 1987. 38p. NTIS, PC A03/MF A01.

A method for nonlinear dynamic effective stress analysis, applicable to soil-structure interaction problems, is described. Full interaction, including slip between structure and foundation, is taken into account. The major factors that must be considered when computing dynamic soil response are incorporated in the computer program TARA-2. Simulated earthquake tests were conducted on centrifuged geotechnical models to obtain prototype response data of foundation soils carrying both surface and embedded structures and to validate the dynamic effective stress analysis. Horizontal and vertical accelerations were measured at various points on structures and in the sand foundation. Seismically-induced porewater pressure changes were also measured at various locations in the foundation. Computer plots of the data were obtained while the centrifuge was in operation, and representative samples are presented. A coherent picture of dynamic response of soil-structure systems is provided by dynamic effective stress nonlinear analysis. Accelerations, porewater pressures, and settlements computed by TARA-2 compared favorably with those recorded during the centrifuge tests, and all phenomenological aspects of dynamic response were reproduced by the analysis.

44225 (AD-A—181198/3/XAB) Strains and stresses near explosions and earthquakes. Report for 5 March-5 September 1986. Burdick, L.J.; Barker, J.S. (Woodward-Clyde Consultants, Pasadena, CA (USA)). 15 Oct 1986. 120p. (WCCP-R—86-02). NTIS, PC A06/MF A01.

Laboratory evidence indicates that, when strains exceed 10^{-6} in media under low confining pressure, certain nonlinear processes begin to occur. They are manifested by a reduction in apparent Q. Since direct measurements of near-field strain are rare, it has been difficult to evaluate whether or not this phenomenon is significantly near to realistic seismic sources. A high-frequency theory for computing stresses and strains using generalized ray theory was developed. It can be shown using this theory that near-field body-wave strain pulses are closely related to near-field velocity pulses. Large data bases of near-field velocity records and crustal structures for modeling them are available. Transfer functions for transforming velocity pulses into estimated strain pulses can be computed by deconvolving theoretical versions of the former from the latter. In most cases they are delta-like functions. These transfers operators were computed for a suite of velocity records from 5 Pahute Mesa Nuclear explosions ranging in yield from 155 to 1300 kt and for an Imperial Valley earthquake of M_0 = 0.6 times 10^{24} dyne-cm. For the explosion data base the strains were as high as 10^{-3}; 3 orders of magnitude higher than the level at which the laboratory data suggests that nonlinear effects become important. The earthquake data base indicated strains levels between 10^{-6} and 10^{-6}. Because of the pressure dependence of the nonlinear phenomenon, it is probably only important in a thin layer near the surface of the earth.

44226 **(AD-A—181208/0/XAB) State-of-the-art for assessing earthquake hazards in the United States. Report 22. Mapping the extent and thickness of liquefiable soil layers at engineering sites. Miscellaneous paper.** Hardman, S.L.; Youd, L.T. (Brigham Young Univ., Provo, UT (USA)). Feb 1987. 201p. NTIS, PC A10/MF A01.

See also Report 23, AD-A181 209.

This study addresses the problem of mapping the subsurface extent and thickness of potentially liquefiable layers in a dam foundation. Accurate delineation of such materials is essential to evaluation of dam safety in seismic regions. Existing techniques for mapping liquefiable sediments are evaluated. Economics, limitations, and usefulness of each method in delineating soil layering are outlined. Case histories are examined that demonstrate the usefulness of each technique under field conditions. For most sediments, the cone penetrometer was found to be the most useful and economical technique for subsurface delineation of liquefiable soil layers. To gain understanding concerning the minimum thickness of liquefiable layer which would be of concern to dam stability (and, thus, must be detected in subsurface investigation), experts in earthquake engineering were surveyed. Several field studies are reviewed to compare the usefulness, advantages, and disadvantages of the several exploratory techniques considered herein.

5803 Mineralogy, Petrology, And Rock Mechanics

REFER ALSO TO CITATION(S) 44218, 44222

44227 **(LA-UR—86-556) Kriging for interpolation of sparse and irregularly distributed geologic data.** Campbell, K. (Los Alamos National Lab., NM (USA)). 1986. Contract W-7405-ENG-36. 19p. (CONF-8608125—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013293.

From American Statistical Association meeting; Chicago, IL, USA (18 Aug 1986).

For many geologic problems, subsurface observations are available only from a small number of irregularly distributed locations, for example from a handful of drill holes in the region of interest. These observations will be interpolated one way or another, for example by hand-drawn stratigraphic cross-sections, by trend-fitting techniques, or by simple averaging which ignores spatial correlation. In this paper we consider an interpolation technique for such situations which provides, in addition to point estimates, the error estimates which are lacking from other ad hoc methods. The proposed estimator is like a kriging estimator in form, but because direct estimation of the spatial covariance function is not possible the parameters of the estimator are selected by cross-validation. Its use in estimating subsurface stratigraphy at a candidate site for geologic waste repository provides an example.

5804 Geochemistry

REFER ALSO TO CITATION(S) 44053

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44228 **(UCRL—53689-86) Institutional Research and Development: [Annual report], FY 1986.** Strack, B. (ed.). (Lawrence Livermore National Lab., CA (USA)). [1987]. Contract W-7405-ENG-48. 329p. NTIS, PC A15/MF A01; 1; GPO Dep. File Number DE87013979.

The Institutional Research and Development (IR & D) program was established at the Lawrence Livermore National Laboratory (LLNL) by the Director in October 1984. The IR & D program fosters exploratory work to advance science and technology; disciplinary research to create varied, innovative approaches to selected scientific fields; and long-term research in support of the defense and energy missions at LLNL. Each project in the IR & D program was selected after personal interviews by the Director and his delegates and was deemed to show unusual promise. These projects include research in the following fields: chemistry and materials science, computation, earth sciences, engineering, nuclear chemistry, biotechnology, environmental consequences of nuclear war, geophysics and planetary physics, and supercomputer research and development. A separate section of the report is devoted to research projects receiving individual awards.

6401 Astrophysics And Cosmology

REFER ALSO TO CITATION(S) 43775, 43776, 43777, 43897, 44383, 44388, 44388, 44410, 44453, 44471, 44635

44229 **(AD-A—180662/9/XAB) Technique for inferring sizes of stellar-active regions.** Dobson-Hockey, A.K.; Radick, R.R. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). 1986. 4p. (AFGL-TR—87-0082). NTIS, PC A02/MF A01.

Pub. in Cool Stars, Stellar Systems and the Sun IV, 202-204(1986).

Inspection of spectroheliograms showing large, well-developed active regions generally show the sunspots to lead the associated plage, in the sense of the solar rotation. Measurements have been made from spectroheliograms of spot-plage offsets and compared with nearly contemporaneous integrated disk observations. Larger active regions generally show larger spot leads; however, information regarding active-region sizes and spot-plage offsets is not readily obtainable form stellar-type observations of the Sun.

44230 **(AD-A—180675/1/XAB) 154-day periodicity in the occurrence of hard solar flares.** Rieger, E.; Share, G.H.; Forrest, D.J.; Kanbach, G.; Reppin, C. (New Hampshire Univ., Durham (USA). Dept. of Physics). 13 Dec 1984. 3p. NTIS, PC A02/MF A01.

Pub. in Nature, Vol. 312, 623-625(13 Dec 1984).

Since the launch of the Solar Maximum Mission (SMM) satellite the gamma ray Spectrometer (GRS) has been monitoring the Sun in the energy range 0.3-1000 MeV. Because of its large geometric area and good spectral resolution, the GRS has provided unprecedented spectral and temporal information about solar flares, of which 139 have been monitored. An analysis of the temporal distribution of these high-energy events provides information on solar activity and find that, instead of being randomly distributed in time, these events have a tendency to occur in groups with a mean spacing of about 154 days (75nHz) over the observing interval. A large sample of flares (>500), with an x ray classification of $>$ or $=$ M 2.5 recorded by the GOES satellite, showed a similar regularity. Keywords: Solar flares.

44231 **(AD-A—181047/2/XAB) Secondary radiation-driven thermal instability. Memorandum report.** Goldberg, L.P.; Dahlburg, R.B. (Naval Research Lab., Washington, DC (USA)). 4 May 1987. 29p. (NRL-MR—5964). NTIS, PC A03/MF A01.

By means of numerical simulation, the authors determine the two-dimensional stability properties of the one-dimensional secondary equilibrium state of a radiation-driven thermally unstable fluid reported by Oran, Mariska, and Boris (1982). It was found that strong secondary instabilities occur, and that the perturbed system tends to move toward a two-dimensional state. The mass density forms clump-like structures, while the temperature profile exhibits a kink-like instability. In an appendix an eigenvalue problem is formulated for the linear stability of the secondary equilibrium.

44232 **(AD-A—181116/5/XAB) Solar distortion measurements. Final report, 29 November 1983-30 September 1986.** Dicke, R.H.; Kuhn, J.R. (Princeton Univ., NJ (USA). Dept. of Physics). 15 Apr 1987. 77p. NTIS, PC A05/MF A01.

Highly accurate solar-limb temperature and shape observations were obtained from Mt Wilson using a highly specialized telescope. The solar oblateness appears to fluctuate on a time scale of years. A latitude-dependent solar-limb temperature variation exists with a temperature amplitude of about 0.6K. This temperature variation is independent of the solar cycle. Reprints included are: Oblateness of the Sun in 1983 and Relativity; On the Facular Contrast Near the Solar Limb; Brightness Variation; Another Reason to Search for Solar g-Modes and New Limits from Solar Ellipticity Measurements; Solar Ellipticity Fluctuations Yield No Evidence of g-Modes; The Variable Oblateness of the Sun: Measurements of 1984; Is the Solar Oblateness Variable. Measurements of 1985;

More evidence for a Solar Latitude Dependent Limb Temperature Variation.

44233 **(AD-A—181118/1/XAB) HELIOS images of coronal mass ejections.** Jackson, B.V. (California Univ., San Diego (USA)). 1986. 7p. NTIS, PC A02/MF A01.

Pub. in The Sun and the Heliosphere in Three Dimensions, 113-118(1986).

The zodiacal light photometers on board the HELIOS spacecraft can be used to form images of coronal mass ejections in the interplanetary medium. Several aspects of these data are unique: they trace coronal mass ejections using Thomson-scattering techniques to distances from the Sun greater than 0.5 AU; their perspective from the HELIOS orbits allow information to be gained about the three-dimensional shapes of specific mass ejections viewed both by coronagraphs and HELIOS; the global view afforded by the spacecraft photometers can image the mass ejection from within and thus relate in situ measurements to the shape of the whole structure. To date, the HELIOS photometers have been used to study coronagraph-observed mass ejections including those which originated at the Sun on 7 May, 24 May and 27 November 1979, and 21 May, 18 June, 29 June and 5 November 1980.

44234 **(AD-A—181135/5/XAB) Application of solar seismology to study of the convection zone. Final report, 10 January 1981-31 December 1986.** Hill, H.A. (Arizona Univ., Tucson (USA). Dept. of Physics). 22 Apr 1987. 53p. NTIS, PC A04/MF A01.

In the 1970's an observational technique for the study of solar oscillations with periods longer than 5 min was developed at SCLERS. The technique yields information about the temperature eigenfunction of an oscillation at the extreme solar limb. The primary goal of the observational program for 1982-1986 was to use this technique to systematically increase the data base for the study of solar oscillations. Because of the complexity of the eigenfrequency spectrum and because of the relatively small signals produced by the oscillations, the analysis of the observations for identification and classification of modes of oscillations has proved to be very difficult. The main objective of the data analysis program for 1982-1086 was to develop analysis techniques which would lead to mode classifications based on the SCLERA differential radius observations and on the combination of the differential radius observations with differential velocity observations. The goal of the theoretical program has been the inversion of the multiplet fine structure obtained in the data analysis program in order first to test if for internal consistency and second infer information about the radial and latitudinal dependence of the internal rotation of the sun.

44235 **(AD-A—181143/9/XAB) Coronal emission-line data and solar-terrestrial predictions.** Altrock, R.C. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). Jun 1984. 14p. (AFGL-TR—87-0169). NTIS, PC A02/MF A01.

Pub. in Solar-Terrestrial Predictions, 131-142(18-22 Jun 1984).

Specific workshop topics included: observations of coronal holes and their evolution; the appearance of coronal features in different emission lines, the use of yellow-line observations for prediction of proton flares, ground-based observations of coronal transients in the green line, and correlations of coronal data with geomagnetic disturbances and anomalous satellite drag. The source of observations for these analyses is emission-line data obtained with the photoelectric coronal photometer at Sacramento Peak Observatory. Previous results are reviewed concerning the high correlation of green-line intensity with the geomagnetic state and the occurrence of anomalous satellite drag. New results on the observations of coronal transients with this system are presented and new observations now being made with this system in the red and yellow lines are described.

44236 **(AD-A—181175/1/XAB) Objective forecasts for solar flares using multivariate discriminant analysis.** Neidig, D.F.; Wiborg, P.H.; Seagraves, P.H.; Hirman, J.W.; Flowers, W.E. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). Jun 1984. 9p. (AFGL-TR—87-0171). NTIS, PC A02/MF A01.

Pub. in Solar-Terrestrial Preditions, p. 300-305(18-22 Jun 1984).

Solar parameters derived from the Region Analysis Program are submitted to a multivariate discriminant analysis (MVDA) in which the parameters relevant to flare prediction are identified and incorporated in a classification procedure to produce a flare forecast. The analysis uses two years of data (3732 solar active region days). The MVDA forecast is compared with a subjective forecast derived from the NOAA forecast during the same period, and is found to be somewhat superior overall. Specific recommendations are made concerning the application of the technique in a forecasting operation.

44237 **(AD-A—181250/2/XAB) Limitations in the use of Hα filament and fibril activity as a short-term (30-minute) predictor of flares and flare-like events.** Neidig, D.F. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). Jun 1987. 8p. (AFGL-TR—87-0172). NTIS, PC A02/MF A01.

Pub. in Solar-Terrestrial Predictions, p187-192(18-22 Jun 1984).

A contingency matrix showing the relationship between flares and H-alpha filament or fibril activity is presented for one active region (NOAA 3221, 20-28 July 1981). Activity in a filament or fibril was defined to exist whenever these structures became visible at H alpha + or - 1A (visibility at these wavelengths is due to mass motions, and may or may not signify the onset of a flare). A chi square test on the observed matrix distribution rejects the null hypothesis at the 0.001 level. Thus the data support the concept of filament-activity flare association as a true physical phenomenon, although the association between these two variables is not observed to be sufficiently strong to render it useful as a short-term flare predictor. Most of the flare events in this study were smaller than subflare class. Nevertheless, the same approximate degree of association was observed between these small flares and their preflare filament activity as has been found in studies of major flares. The result suggests that the filament activity flare association is probably universal and applies to flare activity on very small scales.

44238 **(ANL-HEP-CP—87-47) A layered scintillation detector for solar neutron observations.** Dunphy, P.P.; Chupp, E.L.; Popecki, M.; Spinka, H.; Shima, T.; Lopiano, D.; Glass, G. (New Hampshire Univ., Durham (USA); Argonne National Lab., IL (USA); Texas A and M Univ., College Station (USA)). 1986. Contract W-31109-ENG-38. 5p. (CONF-8608186—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011354.

From 20. international cosmic ray conference; Moscow, USSR (2 Aug 1986).

A detector technique suitable for measurement of high-energy (10 to 1000) MeV solar neutrons and γ rays is discussed. A prototype instrument has been constructed for testing, using three layers of NaI with a total thickness of 30 cm, a Cerenkov detector, and charged particle shields. The response of this prototype to neutrons in the range (38 to 720) MeV has been measured, using a neutron beam at the Los Alamos Meson Physics Facility. Some results of these measurements are presented.

44239 **(BNL—39918) Measurements of $\sin^2 \theta$/sub w/ from studies of the elastic scattering of neutrinos by protons and electrons.** Mann, A.K. (Brookhaven National Lab., Upton, NY (USA); Pennsylvania Univ., Philadelphia (USA). Dept. of Physics). 1986. Contract AC02-76CH00016. 24p. (CONF-860150—9). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012480.

From Winter condensed matter physics conference: frontiers in condensed matter X-ray physics; Aspen, CO, USA (12 Jan 1986).

This talk is intended as a brief report on studies of the elastic scattering of neutrinos by protons and electrons. Measurements of the ratios of muon antineutrino and muon neutrino elastic scattering on protons, and the corresponding ratio for elastic scattering on electrons minimize systematic experimental errors, and lead directly to values of the fundamental parameter of the electroweak interaction, the Weinberg Angle, with minimal ambiguity. Accordingly, the principal motivation in carrying out these studies was the desire to obtain and compare precise values of the Weinberg Angle from both the semileptonic and leptonic reactions as still another test of the basic validity of the standard electroweak theory. 10 refs., 11 figs.

44240 **(CEA-CONF—8678) Nucleosynthesis of /sup 26/ Al.** Casse, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Fondamentale (IRF)). Jul 1986. 9p. (CONF-8606145—11). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752344.

From 26. Committee on Space Research meeting; Toulouse, France (30 Jun 1986).

A burst of interest has followed the discovery in the galactic plane of the 1.8 MeV gamma line attached to the decay of /sup 26/ Al. We discuss the relative merits of supernovae, novae, massive and supermassive mass-losing stars as potential sources of this expressive isotope.

44241 **(CEA-CONF—8756) EXOSAT observations of omega centauri.** Koch-Miramond, L. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Fondamentale (IRF)). Aug 1986. 3p. (CONF-8608180—1). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752345.

From TAU symposium on globular cluster systems in galaxies; Cambridge, MA, USA (25 Aug 1986).

We have undertaken an EXOSAT study of Omega Cen to tackle the two aspects of its X-ray emission revealed by the Einstein satellite: (I) diffuse emission which could be due to the interaction between the gas lost by the evolving cluster stars and the interstellar medium; (II) dim point sources, the major part of them being white-dwarf binaries.

44242 **(CEA-CONF—8786) About the standard solar model.** Cahen, S. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Fondamentale (IRF)). Jul 1986. 9p. (CONF-860793—5). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752346.

From 2. IAP meeting on nuclear astrophysics; Paris, France (7 Jul 1986).

A discussion of the still controversial solar helium content is presented, based on a comparison of recent standard solar models. Our last model yields an helium mass fraction —0.276, 6.4 SNU on /sup 37/ Cl and 126 SNU on /sup 71/Ga.

44243 **(CEA-CONF—8787) Supernova explosion in a very massive star.** El Eid, M.F.; Langer, N. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Fondamentale (IRF)). Jul 1986. 11p. (CONF-860793—6). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752347.

From 2. IAP meeting on nuclear astrophysics; Paris, France (7 Jul 1986).

We describe the final evolution of a 100 solar mass following an evolutionary scenario during which the star evolves from a Wolf-Rayet stage through the electron- positron pair creation supernova. We find that the star is completely disrupted by explosive oxygen burning, and this type of explosion as a possible scenario for the Cassiopeia A remnant. This scenario seems to be also applicable to the supernova 1985f according to the recent observations of this object.

44244 **(CEA-CONF—8788) Nucleosynthesis in pair creation supernova.** El Eid, M.F. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Fondamentale (IRF)). Jul 1986. 8p. (CONF-860793—7). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752348.

From 2. IAP meeting on nuclear astrophysics; Paris, France (7 Jul 1986).

The investigation of the possibility that some of the oxygen-rich supernova remnants may have been produced by exploding Wolf-Rayet stars via electron-positron pair creation supernovae, requires detailed informations about the heavy element production in such events. This problem is discussed in this contribution, and it is in particular emphasized that for an exploding Wolf-Rayet star of about 50 Solar mass the synthesis of radioactive species (especially /sup 56/Ni) is probably negligible; hence radioactive decay is unlikely to power the optical luminosity of the supernova.

44245 **(CEA-CONF—8789) Cosmic rays: material from coronae of ordinary stars and from He-Burning zones, but not from s-process sites.** Meyer, J.P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Fondamentale (IRF)). Jul 1986. 15p. (CONF-860793—8). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752349.

From 2. IAP meeting on nuclear astrophysics; Paris, France (7 Jul 1986).

The Galactic Cosmic Ray composition seems to tell us that the bulk of the galactic cosmic ray nuclei were first extracted out of the coronae of ordinary F to M stars. They were most likely first accelerated to MeV energies by stellar flares, and later on boosted up to GeV energies by supernova remnants (and possibly massive star wind) shocks. A small fraction of them (— 2%) should originate in He-burning material, plausibly in Wolf-Rayet stars. The most recent analysis of the HEAO-C3 data does not confirm last year's indications of an excess of s- (and possibly r-) nuclei with N $>$ 50.

44246 **(CEA-CONF—8790) Massive stars, x-ray ridge, and galactic /sup 26/Al gamma-ray line emission.** Montmerle, T. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Fondamentale (IRF)). Jul 1986. 9p. (CONF-860793—9). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752350.

From 2. IAP meeting on nuclear astrophysics; Paris, France (7 Jul 1986).

Massive stars interact with their parent molecular cloud by means of their ionizing flux and strong winds, thereby creating giant, hollow HII regions. To account for the observed structure of these HII regions, it appears necessary that all the wind energy be dissipated. Dorland and Montmerle have recently proposed a new dissipation mechanism, in the process, diffuse hard X-rays are emitted. If the observed galactic X-ray "ridge" results from this process on a galactic scale, it can be accounted for by the interaction of — 3000 Wolf-Rayet stars (mostly within a —6.5 kpc ring) with their surrounding interstellar gas. This result is essentially consistent with the suggestion by Prantzos and Casse that the galactic /sup 26/Al γ-ray line emission originates in Wolf-Rayet stars.

44247 **(CEA-CONF—8791) Gamma-ray-line astronomy: the case of /sup 26/Al.** Prantzos, N. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Fondamentale (IRF)). Jul 1986. 14p. (CONF-860793—10). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752351.

From 2. IAP meeting on nuclear astrophysics; Paris, France (7 Jul 1986).

The recent detection of the 1.8 MeV line in the galactic plane, attributed to the decay of — 3 Solar mass of radioactive / sup 26/Al, brought closer together the disciplines of gamma-ray Astronomy and Nuclear Astrophysics. A review is presented here of the possible production mechanisms and sites of /sup 26/Al in the Galaxy, with an emphasis on the role of massive, mass losing stars.

44248 **(CEA-CONF—8792) Trends in nuclear astrophysics.** Reeves, H. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Fondamentale (IRF)). Jul 1986. 22p. (CONF-860793—11). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752352.

From 2. IAP meeting on nuclear astrophysics; Paris, France (7 Jul 1986).

Two instances in which the good success of standard Big Bang nucleosynthesis in reproducing the abundance observations of the light elements has been used for the development of high energy physics and of early cosmological models have been described. The first case is in relation with the families of elementary particles the other case is in the formulation of multidimensional cosmologies (as superstring theories) taking into account the observed constancies of the 4-D versions of the coupling constants.

44249 (FNAL/Pub—87/106-A) The large scale microwave background anisotropy in decaying particle cosmology. Panek, M. (Fermi National Accelerator Lab., Batavia, IL (USA)). Jun 1987. Contract AC02-76CH03000. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013482.

We investigate the large-scale anisotropy of the microwave background radiation in cosmological models with decaying particles. The observed value of the quadrupole moment combined with other constraints gives an upper limit on the redshift of the decay z/sub d/ < 3-5. 12 refs., 2 figs.

44250 (FNAL/Pub—87/110-A) Supernova 1987a and the secret interactions of neutrinos. Kolb, E.W.; Turner, M.S. (Fermi National Accelerator Lab., Batavia, IL (USA); Osservatorio Astronomico, Rome (Italy); Chicago Univ., IL (USA). Dept. of Astronomy and Astrophysics; Chicago Univ., IL (USA). Enrico Fermi Inst.). Jul 1987. Contract AC02-76CH03000. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013478.

By using SN 1987a as a 'source' of neutrinos with energy ~10 MeV we place limits on the couplings of neutrinos with cosmic background particles. Specifically, we find that the Majoron-electron neutrino coupling must be less than about 10^{-3}; if neutrinos couple to a massless vector particle, its dimensionless coupling must be less than about 10^{-3}; and if neutrinos couple with strength g to a massive boson of mass M, then g/M must be less than 12 MeV^{-1}. 11 refs., 3 tabs.

44251 (FNAL/Pub—87/116-A) Chaotic universe dynamics using a Fokker-Planck equation. Coule, D.H.; Olynyk, K.O. (Fermi National Accelerator Lab., Batavia, IL (USA)). Jul 1987. Contract AC02-76CH03000. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013481.

A Fokker-Planck equation that accounts for fluctuations in field and its conjugate momentum is solved numerically for the case of a λ phi^4 potential. Although the amount of inflation agrees closely with that expected classically, in certain cases (large initial fields or large dispersions),the "slow rolling" approximation appears invalid. In such cases inflation would stop prematurely before possibly restarting. 18 refs., 2 figs.

44252 (INIS-BR—712, pp 221-246) Early Universe. Marques, G.C. (Sao Paulo Univ., Brazil. Inst. de Fisica). 1985. (In Portuguese). NTIS (US Sales Only), PC A12/MF A01. File Number DE87703464. (CONF-8508241—).

From 8. workshop on nuclear physics; Sao Lourenco, MG, Brazil (31 Aug 1985).

Some striking consequences experimentaly confirmed (such as background radiation and element abundance) which point toward of the existence of a genesis for the Universe are discussed. (L.C.).

44253 (LA-UR—87-2314) Modes, masses, metallicities, and magnitudes of RR Lyrae variables. Cox, A.N. (Los Alamos National Lab., NM (USA)). 1 Jul 1987. Contract W-7405-ENG-36. 12p. (CONF-8706143—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013149.

From IAU colloquium 95; Tucson, AZ, USA (1 Jun 1987).

The author reviews past and recent developments in the study of RR Lyrae variables. He provides supporting evidence for a large helium content but remains uncertain as to their masses and luminosities. Time dependent convection is offered as a probable explanation for the double mode pulsations of these stars. 25 refs., 8 figs., 3 tabs.

44254 (N—87-22103, pp vp) IONS (ANURADHA): ionization states of low energy cosmic rays. Biswas, S.; Chakraborti, R.; Cowsik, R.; Durgaprasad, N.; Kajarekar, P.J.; Singh, R.K.; Vahia, M.N.; Yadav, J.S.; Dutt, N.; Goswami, J.N. (Physical Research Lab., Ahmedabad, India). Feb 1987. NTIS, PC A05/MF A01. (CONF-8512137—; NASA-CP—2429; M—547; NAS—1.55:2429).

From Spacelab 3 mission science review meeting; Huntsville, AL, USA (4 Dec 1985).

IONS (ANURADHA), the experimental payload designed specifically to determine the ionization states, flux, composition, energy spectra and arrival directions of low energy (10 to 100 MeV/amu) anomalous cosmic ray ions of helium to iron in near-Earth space, had a highly successful flight and operation Spacelab-3 mission. The experiment combines the accuracy of a highly sensitive CR-39 nuclear track detector with active components included in the payload to achieve the experimental objectives. Post-flight analysis of detector calibration pieces placed within the payload indicated no measurable changes in detector response due to its exposure in spacelab environment. Nuclear tracks produced by alpha-particles, oxygen group and Fe ions in low energy anomalous cosmic rays were identified. It is calculated that the main detector has recorded high quality events of about 10,000 alpha-particles and similar number of oxygen group and heavier ions of low energy cosmic rays.

44255 (N—87-22567) Abundance and distribution of water vapor in Jupiter's atmosphere. Bjoraker, G.L.; Larson, H.P.; Kunde, V.G. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Sep 1986. 72p. (NASA-TM—88366; PREPRINT—61; A—86412; NAS—1.15:88366). NTIS, PC A04/MF A01.

The atmospheric transmission window between 1800 and 2250 cm(-1) in Jupiter's atmosphere was observed from the Kuiper Airborne Observatory (KAO) and by the infrared spectrometer (IRIS) on Voyager. The vertical distribution of H_2O was derived for the 1 to 6 bar portion of Jupiter's troposphere. The spatial variation of H_2O was measured using IRIS spectra of the Hot Spots in the North and South Equatorial Belts, the Equatorial Zone, and for an average of the North and South Tropical Zones. The H_2O column abundance above the 4 bar level is the same in the zones as in the SEB Hot Spots, about 20 cm-amagat. The NEB Hot Spots are desiccated by a factor of 3 with respect to the rest of Jupiter. For an average between -40 to 40 deg latitude, the H_2O mole fraction, qH_2O, is saturated for P less than 2 bars, $qH_2O = 4x10$ to the -6 in the 2 to 4 bar range and it increases to 3x10 to the -5 at 6 bars. A similar vertical profile applies to the spatially resolved zone and belt spectra, except that H_2O falls off more rapidly at P less than 4 bars in the NEB Hot Spots. The massive H_2O cloud at 5 bars, T = 273 K, proposed in solar composition models, is inconsistent with the observations. Instead, a thin H_2O ice cloud would form at 2 bars, T = 200 K. The O/H ratio in Jupiter, inferred from H_2O measurements in both belts and zones at 6 bars, is depleted by a factor of 50 with respect to the Sun. The implications for the origin of Jupiter of globally depleted O/H, but enhanced C/H and N/H, are discussed.

44256 (N—87-22572) IUE observations of Mg_2 emission form Miras. Semiannual report. Brugel, E.W. (Colorado Univ., Boulder (USA). Cooperative Inst. for Research in Environmental Sciences). May 1987. 6p. (NASA-CR—180603; NAS—1.26:180603). NTIS, PC A02/MF A01.

A total of 61 well exposed low dispersion LWP observations were obtained from the brightest normal M-type Mira variables around their pulsation cycles. By observing Mg II throughout the cycle, the intent is to determine the shock luminosity and duration, and the density in the upper atmospheres of Miras. The data also provide a mechanism for probing the radiative cooling in postshock regions of the atmosphere as a function of time. A summary of data acquired for IUE programs SRHLW and MGIEB is presented.

44257 (N—87-22585) Size distribution of instellar grains. Final technical report. Witt, A.N. (Toledo Univ., OH (USA)). May 1987. 9p. (NASA-CR—180593; NAS—1.26:180593). NTIS, PC A02/MF A01.

Three major areas involving interstellar grains were investigated. First, studies were performed of scattering in reflection nebulae with the goal of deriving scattering characteristics of dust grains such as the albedo and the phase function asymmetry throughout the visible and the ultraviolet. Secondly, studies were performed of the wavelength dependence of interstellar extinction designed to demonstrate the wide range of grain size distributions naturally occurring in individual clouds in different parts of the galaxy. And thirdly, studies were also performed of the ultraviolet powered emission of dust grains in the 0.5 to 1.0 micron wave-

length range in reflection nebulae. Findings considered of major importance are highlighted.

44258 **(N—87-22590) Study of the Io-associated plasma and neutral sodium cloud. Final technical report.** Pilcher, C.B.; Cruikshank, D.P. (Hawaii Univ., Honolulu (USA)). May 1987. 10p. (NASA-CR—180595; NAS—1.26:180595). NTIS, PC A02/MF A01.

Narrow-band interference filter images were obtained for the Io torus at the S II wavelengths of 6716, 6731 and at the wavelenght of the S III, 9532 spectrum. The purpose of these observations is to study the short term temporal behavior of the torus and to gain a better understanding of the systematic morphology of the torus. From these images, estimates were obtained for the electron and ion densities and ion temperatures as a function of longitude, latitude, radius from Jupiter, and time. From the analysis of images taken in 1983 and 1984, extremely sharp longitudinal variations in plasma density were detected, subcorotational velocities were measures in the torus plasma, the presence of an optical east-west brightness asymmetry was confirmed in the ion emissions, and longitudinal variations were detected in torus ion temperatures.

44259 (N—87-23313, pp vp) **Beamed emission from gamma-ray burst sources.** Epstein, R. May 1987. NTIS, PC A14/MF A01. (CONF-8603207—; NASA-CP—2469; M—560; NAS—1.55:2469).

From Double layers in astrophysics conference; Huntsville, AL, USA (17 Mar 1986).

Gamma-ray bursts are intense fluxes of radiation in the 100 keV to several MeV energy range which typically persist for between a fraction of a second to several seconds. The observed spectral shape of these bursts suggest that the radiation is emitted as highly collimated beams emanating from neutron stars. This inference is based on the lack of significant gamma-gamma absorption (which are produced when gamma rays interact with stellar surfaces). The gamma-ray beams may be a consequence of a particle acceleration in double layers in neutron star magnetospheres.

44260 (N—87-23313, pp vp) **Double layers and plasma-wave resistivity in extragalactic jets: Cavity formation and radio-wave emission.** Borovsky, J. E. May 1987. NTIS, PC A14/MF A01. (CONF-8603207—; NASA-CP—2469; M—560; NAS—1.55:2469).

From Double layers in astrophysics conference; Huntsville, AL, USA (17 Mar 1986).

For estimated values of the currents carried by extragalactic jets, current-driven electrostatic-wave- and electromagnetic-wave-produced resistivities do not occur. Strong plasma double layers, however, may exist within self-maintained density cavities, the relativistic double-layer-emitted electron, and ion beams driving plasma-wave resistivities in the low- and high-potential plasma adjacent to the double layers. The double-layer-emitted electron beams may also emit polarized radio waves via a collective bremsstrahlung process mediated by electrostatic two-stream instabilities.

44261 (N—87-23313, pp vp) **Accretion onto neutron stars with the presence of a double layer.** Williams, A.C.; Weisskopf, M.C.; Elsner, R.F.; Darbro, W.; Sutherland, P.G. (McMaster Univ., Hamilton, Ontario). May 1987. NTIS, PC A14/MF A01. (CONF-8603207—; NASA-CP—2469; M—560; NAS—1.55:2469).

From Double layers in astrophysics conference; Huntsville, AL, USA (17 Mar 1986).

It is known, from laboratory experiments, that double layers will form in plasmas, usually in the presence of an electric current. It is argued that a double layer may be present in the accretion column of a neutron star in a binary system. It is suggested that the double layer may be the predominant deceleration mechanism for the accreting ions, especially for sources with x-ray luminosities of less than about 10 to the 37th erg/s. Previous models have involved either a collisionless shock or an assumed gradual deceleration of the accreting ions to thermalize the energy of the infalling matter.

44262 **(N—87-23336) Study of the fundamental characteristics of 2175A extinction. semiannual progress report.** Cardelli, J.A.; Savage, B.D. (Wisconsin Univ., Madison (USA)). Jun 1987. 45p. (NASA-CR—180926; NAS—1.26:180926). NTIS, PC A03/MF A01.

The characteristics of interstellar extinction were studied in the region of the 2175 A feature for lines of sight which appear to exhibit unusually weak ultraviolet extinction. The analysis was based upon a parameterization of the observed extinction via fitting specific mathematical functions in order to determine the position and width of the 2175 A feature. The data are currently being analyzed.

44263 **(N—87-23340) Numerical studies of collapsing interstellar clouds. Final technical report.** Bodenheimer, P.; Villere, K.R.; Black, D.C. (California Univ., Santa Cruz (USA)). May 1987. 25p. (NASA-CR—180933; NAS—1.26:180933). NTIS, PC A02/MF A01.

Numerical simulation of the structure and evolution of interstellar clouds was conducted. Steps were taken toward an integrated treatment of the dynamical, thermal, and chemical processes entering model calculations, and a detailed study was made of radiative transfer in molecular lines to allow model predictions to be tested against empirical data. It is shown that the shapes of molecular lines are sensitive to details of the cloud structure and evolutionary state and are thus useful in inferring the cloud density, temperature, chemical composition, age, and initial conditions. The calculations have successfully reproduced and explained several observed cloud properties, including abundances of complex molecular species and the apparent depletion of CO in dense cores.

44264 **(N—87-23341) Reports of planetary geology and geophysics program, 1986.** (National Aeronautics and Space Administration, Washington, DC (USA)). May 1987. 558p. (NASA-TM—89810; NAS—1.15:89810). NTIS, PC A24/MF A01.

Abstracts compiled from reports from Principal Investigators of the NASA Planetary Geology and Geophysics Program, Office of Space Science and Applications are presented. The purpose is to document in summary form work conducted in this program during 1986. Each report reflects significant accomplishments within the area of the author's funded grant or contract.

44265 (N—87-23341, pp 3) **Mechanical and thermal properties of planetologically important ices.** Croft, S.K. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

Two squences of ice composition were proposed for the icy satellites: a dense nebula model and a solar nebula model. Careful modeling of the structure, composition, and thermal history of satellites composed of these various ices requires quantitative information on the density, compressibility, thermal expansion, heat capacity, and thermal conductivity. Equations of state were fitted to the density data of the molecular ices. The unusual thermal and mechanical properties of the molecular and binary ices suggest a larger range of phenomena than previously anticipated, sufficiently complex perhaps to account for many of the unusual geologic phenomena found on the icy satellites.

44266 (N—87-23341, pp 1) **Could Ariel have been heated by tidal friction?.** Peale, S.J. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

For significant dissipation in Ariel, the past existence of an orbital resonance to force and maintain a substantial eccentricity in the orbit is hypothesized. The absolute maximum dissipation rate would be reduced both by the time necessary to establish the resonance in the first place and by a consequently larger minimum Q. The actual heating rate was much less than this maximum so even the existence of a 2/1 resonance may not be sufficient to account for Ariel's smooth sufrace.

44267 (N—87-23341, pp 3) **SO_2 on Io: a thermodynamic perspective.** Zent, A.P.; Fanale, F.P. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

The presence of condensed SO_2 on Io mandates a finite abundance of SO_2 vapor which must be present, regardless of plume activity. The absorption of SO_2 was measured on particulate sulfur and the equilibrium between absorbed SO_2, SO_2 vapor, and SO_2 ice examined, based upon measurements and simple thermodynamic considerations.

44268 (N—87-23341, pp 3) **Experimental studies on the impact properties of water ice.** Bridges, F.G.; Lin, D.N.C.; Hatzes, A.P. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

Experimental studies on the impact of ice particles at very low velocity were continued. These measurements have applications in the dynamics of Saturn's rings. Initially data were obtained on the coefficient of restitution for ice spheres of one radius of curvature. The type of measurements were expanded to include restitution data for balls with a variety of surfaces as well as sticking forces between ice particles. Significant improvements were made to this experiment, the most important being the construction of a new apparatus. The new apparatus consists of a smaller version of the disk pendulum and a stainless steel, double-walled cryostat. The apparatus has proved to be a significant improvement over the old one. Measurements can now be made at temperatures near 90 K, comparable to the temperature of the environment of Saturn's rings, and with much greater temperature stability. It was found that a roughened contact surface or the presence of frost can cause a much larger change in the restitution measure than the geometrical effect of the radius of curvature.

44269 (N—87-23341, pp 1) **Temperatures and minimum thickness of the inactive surface layer of comet Halley.** Fanale, F.P.; Salvail, J.R. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

The effects of a nonvolatile mantle on the thermal state of a comet nucleus are investigated. The original computer model was modified so that temperatures can be computed through a thin dust mantle to the center of a 5 km spherical nucleus in the orbit of P/Halley. No attempt is made to simulate the formation of the mantle. Results are obtained for various specified values of initial mantle thickness and thermal conductivity to determine their effects on temperature profiles through the mantle. The minimum thickness of mantle that can withstand ejection by sublimating gasses is also calculated as a function of mantle thermal conductivity. Calculations were performed for ten or more orbits until temperatures in the mantle reached a near steady state. Results indicate that mantles as thin as 4 cm and 14 cm, for thermal conductivities of 600 and 6000 ergs/cm/s K, respectively, will remain intact. Surface temperatures as high as 511 K at perihelion and 400 K at the position of spacecraft encounter were computed at 0 degree latitude for an upright, rotating nucleus. Ice interface temperatures were raised by different amounts during each orbit, depending on mantle thickness and thermal conductivity, until steady state was reached. These results imply that relatively small nonvolatile masses emplaced randomly in comet nuclei could produce an irregular, permanently mantled surface and could also account for the apparently random location of active areas.

44270 (N—87-23341, pp 3) **Comet thermal modeling.** Weissman, P.R.; Kieffer, H.H. (Geological Survey, Flagstaff, AZ). May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

The past year was one of tremendous activity because of the appearance of Halley's Comet. Observations of the comet were collected from a number of sources and compared with the detailed predictions of the comet thermal modeling program. Spacecraft observations of key physical parameters for cometary nucleus were incorporated into the thermal model and new cases run. These results have led to a much better understanding of physical processes on the nucleus and have pointed the way for further improvements to the modeling program. A model for the large-scale structure of cometary nuclei was proposed in which comets were envisioned as loosely bound agglomerations of smaller icy planetesimals, essentially a rubble pile of primordial dirty snowballs. In addition, a study of the physical history of comets was begun, concentrating on processes during formation and in the Oort cloud which would alter the volatile and nonvolatile materials in cometary nuclei from their pristine state before formation.

44271 (N—87-23341, pp 1) **Loss and depth of CO_2 ice in comet nuclei.** Fanale, F.P.; Salvail, J.R. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

An analytical model was developed to simulate the material differentiation of a cometary nucleus composed of water ice, putative unclathrated CO_2 ice and silicate dust in specified proportions. Selective sublimation of any free CO_2 ice present in a comet would produce a surface layer of water ice and dust overlying the original CO_2 rich material. This surface layer reduces the temperature of buried CO_2 ice and restricts the outflow of gaseous CO_2. On each orbit, water sublimation at smaller heliocentric distances temporarily reduces the thickness of the water ice and dust layer and liberates dust. The model includes the effects of nucleus rotation, arbitrary orientation of the rotation axis, latitude, heat conduction into the deep interior of the nucleus and restriction of CO_2 gas outflow by the water ice and dust layer. The effects of the permeability of the surface water ice layer, the nucleus rotation rate, and the latitude were investigated. Comparison of these and similar results with observations could yield information regarding the permeability and chemical composition of cometary material and suggest sampling strategies to minimize fractionation effects.

44272 (N—87-23341, pp 2) **Dynamics of long period comets.** Weissman, P.R. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

The appearance of Halley's Comet in 1985 to 1986 and the related emphasis on research on physical models of cometary nuclei, led to a more moderate pace for the dynamical studies of the Oort cloud and the motion of long-period comets this year. Specific areas studied included the dynamical evolution of cometary showers as a result of stars passages through the inner Oort cloud and the possible relationship to observed stepwise mass extinctions at geological boundaries, revised estimates for the total mass of comets in the Oort cloud as a result of lessons learned from the spacecraft encounters with Halley's Comet, and study of the possible dynamical sources for the short-period comets in the solar system as part of a wider study of physical processing of cometary nuclei prior to their becoming visible comets. The work on cometary showers used a Monte Carlo simulation of the evolution of cometary orbits under a combination of planetary, nongravitational, and stellar perturbations, and with physical removal by disruption, sublimation of all volatiles, and collision.

44273 (N—87-23341, pp 3) **Observations on the magnitude-frequency distribution of Earth-crossing asteroids.** Shoemaker, E.M.; Shoemaker, C.S. (Arizona Research and Technology, Flagstaff). May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

During the past decade, discovery of Earth-crossing asteroids has continued at the pace of several per year; the total number of known Earth crossers reached 70 as of September, 1986. The sample of discovered Earth crossers has become large enough to provide a fairly strong statistical basis for calculations of mean probabilities of asteroid collision with the Earth, the Moon, and Venus. It is also now large enough to begin to address the more difficult question of the magnitude-frequency distribution and size distribution of the Earth-crossing asteroids. Absolute V magnitude, H, was derived from reported magnitudes for each Earth crosser

on the basis of a standard algorithm that utilizes a physically realistic phase function. The derived values of H range from 12.88 for (1627) Ivar to 21.6 for the Palomar-Leiden object 6344, which is the faintest and smallest asteroid discovered.

44274 (N—87-23341, pp 2) **Asteroid families, dynamics and astrometry.** Williams, J.G.; Gibson, J. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

The proper elements and family assignments for the 1227 Palomar-Leiden Survey asteroids of high quality were tabulated. In addition to the large table, there are also auxiliary tables of Mars crossers and commensurate objects, histograms of the proper element distributions, and a discussion. Probably the most important part of the discussion describes the Mars crossing boundary, how the closest distances of approach to Mars and Jupiter are calculated, and why the observed population of Mars crossers should bombard that planet episodically rather than uniformly. Analytical work was done to derive velocity distributions of family forming events from proper element distributions subject to assumptions which may be appropriate for cratering events. Software was developed for a microcomputer to permit plotting of the proper elements. Three orthogonal views are generated and stereo pairs can be printed when desired. This program was created for the study of asteroid families. The astrometry task is directed toward measuring and reducing positions on faint comets and the minor planets with less common orbits. The observational material is CCD frames taken with the Palomar 1.5 m telescope. Positions of 10 comets and 16 different asteroids were published on the Minor Planet Circulars.

44275 (N—87-23341, pp 3) **1986 DA and 1986 EB: M-class asteroids in near-Earth orbits.** Gradie, J.; Tedesco, E. (Jet Propulsion Lab., Pasadena, CA). May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

The Earth-approaching asteroid population is composed of asteroids in orbits with short lifetimes compared with the age of the solar system. These objects which are comprised of Aten, Apollo, and Amor asteroids must be replenished from either cometary or mainbelt asteroid sources since lifetimes against collision with or ejection by a planet are on the order of 10 to 100 million years. The physical study of Earth-approaching asteroids is constrained by the generally long period between favorable apparitions and poorly known orbits. Broadband spectrophotometry on the Johnson UBVR system and the Eight-Color Asteroid Survey system were obtained at Kitt Peak National Observatory and on the Johnson JHK system and at 10 and 20 microns at the NASA Infrared Telescope Facility at Mauna Kea Observatory. These observations were used to determine the absolute visual magnitudes and to derive the visual geometric albedos and diameters on the IRAS system. The spectral reflectance properties and geometric albedos of the M-class asteroids are consistent compositions analogous to the iron nickel meteorites or the enstatite-metal assemblages of the enstatite chondrites. The issue of the source(s) of the near-Earth asteroids population was examined by comparing the classifications on the scheme employed by Gradie and Tedesco of 38 such asteroids. Most of the near-Earth objects is indeed the asteroid belt as the observations suggest, then a method for removing extinct nuclei of short period comets must be found since the rate of production of short period comets from the long period comets is relatively large.

44276 (N—87-23341, pp 3) **Meteorite spectroscopy and characterization of asteroid surface materials.** Gaffey, M.J. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

The purpose of this research effort is to improve the understanding of the origin, evolution, and interrelationships of the asteroids; of their relationships to the meteorites; and of the conditions and processes in the early inner solar system. The surface mineral assemblage and the surface heterogeneity of selected minor planets is determined from analysis of telescopic spectra to provide the data base to accomplish these goals. The analysis of asteroidal visible and near-infrared (VNIR) reflectance spectra compliments meteorite studies as a means of probing the late nebular through the early post-accretionary period of solar system history. To date, essentially all available spectral evidence has strongly indicated that the large S-type asteroids are predominantly thermally evolved, magmatically differentiated bodies.

44277 (N—87-23341, pp 1) **Source of the optical red-slope in iron-rich meteorites.** Britt, D.T.; Pieters, C.M.; Schultz, P.H. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

The relationship between ordinary chondrites and S-type asteroids is an unresolved issue in meteorite science. S-type asteroids exhibit a positively red-sloped spectrum that is interpreted to indicate the presence of elemental iron on the surfaces. The characteristic red-sloped spectrum of iron-rich meteorites is produced by only the specular component of the reflectance. Complex metallic surfaces can be modeled as linear mixtures of specular and nonspecular components. It is the geometry of the metal on a surface and its interaction with surrounding material, rather than the absolute amount of metal, that determine the redness of resulting spectra. In order to distinguish between ordinary chondrite and differentiated parent bodies it is important to understand how regolith processes affect the nature and form of metal on asteroid surfaces.

44278 (N—87-23341, pp 3) **Analytical electron microscopy of fine-grained phases in primitive interplanetary dust particles and carbonaceous chondrites.** Mackinnon, I.D.R.; Rietmeijer, F.J.M.; Mckay, D.S. (New Mexico Univ., Albuquerque). May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

In order to describe the total mineralogical diversity within primitive extraterrestrial materials, individual interplanetary dust particles (IDPs) collected from the stratosphere as part of the JSC Cosmic Dust Curatorial Program were analyzed using a variety of AEM techniques. Identification of over 250 individual grains within one chondritic porous (CP) IDP shows that most phases could be formed by low temperature processes and that heating of the IDP during atmospheric entry is minimal and less than 600 C. In a review of the mineralogy of IDPs, it was suggested that the occurrence of other silicates such as enstatite whiskers is consistent with the formation in an early turbulent period of the solar nebula. Experimental confirmation of fundamental chemical and physical processes in a stellar environment, such as vapor phase condensation, nucleation, and growth by annealing, is an important aspect of astrophysical models for the evolution of the Solar System. A detailed comparison of chondritic IDP and carbonaceous chondrite mineralogies shows significant differences between the types of silicate minerals as well as the predominant oxides.

44279 (N—87-23341, pp 3) **Accumulation of the planets.** Wetherill, G.W. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

In modeling the accumulation of planetesimals into planets, it is appropriate to distinguish between two stages: an early stage, during which approximately 10 km diameter planetesimals accumulate locally to form bodies approximate 10 to the 25th g in mass; and a later stage in which the approximately 10 to the 25th g planetesimals accumulate into the final planets. In the terrestrial planet region, an initial planetesimal swarm corresponding to the critical mass of dust layer gravitational instabilities is considered. In order to better understand the accumulation history of Mercury-sized bodies, 19 Monte-Carlo simulations of terrestrial planet growth were calculated. A Monte Carlo technique was used to investigate the orbital evolution of asteroidal collision debris produced interior to 2.6 AU. It was found that there are two regions primarily responsible for production of Earth-crossing meteoritic material and Apollo objects. The same techniques were extended to include the origin of Earth-approaching asteroidal bodies. It is found that these same two resonant mechanisms predict a steady-state number of

Apollo-Amor about 1/2 that estimated based on astronomical observations.

44280 (N—87-23341, pp 3) **Protostellar disks and the primitive solar nebula.** Cassen, P.M.; Pollack, J.B.; Bunch, T.; Hubickyj, O.; Moins, P.; Yuan, C. (City College of the City Univ. of New York, NY). May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

The objective is to obtain quantitative information on the turbulent transport of mass, angular momentum, and energy under the conditions that characterize the solar nebula, by direct numerical calculations. These calculations were made possible by research conducted on supercomputers (Cray XMP and Cray 2) by the Ames Computational Fluid Dynamics Branch. Techniques were developed that permitted the accurate representation of turbulent flows over the full range of important eddy sizes. So far, these techniques were applied (and verified) primarily in mundane laboratory situations, but they have a strong potential for astrophysical applications. A sequence of numerical experiments were conducted to evaluate the Reynold's stress tensor, turbulent heat transfer rate, turbulent dissipation rate, and turbulent kinetic energy spectrum, as functions of position, for conditions relevant to the solar nebula. Emphasis is placed on the variation of these properties with appropriate nondimensional quantities, so that relations can be derived that will be useful for disk modeling under a variety of hypotheses and initial conditions.

44281 (N—87-23341, pp 1) **Formation of giant molecular clouds in global spiral structures: the role of orbital dynamics and cloud-cloud collisions.** Roberts, W.W. Jr.; Stewart, G.R. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

The different roles played by orbital dynamics and dissipative cloud-cloud collisions in the formation of giant molecular clouds (GMCs) in a global spiral structure are investigated. The interstellar medium (ISM) is simulated by a system of particles, representing clouds, which orbit in a spiral-perturbed, galactic gravitational field. The overall magnitude and width of the global cloud density distribution in spiral arms is very similar in the collisional and collisionless simulations. The results suggest that the assumed number density and size distribution of clouds and the details of individual cloud-cloud collisions have relatively little effect on these features. Dissipative cloud-cloud collisions play an important steadying role for the cloud system's global spiral structure. Dissipative cloud-cloud collisions also damp the relative velocity dispersion of clouds in massive associations and thereby aid in the effective assembling of GMC-like complexes.

44282 (N—87-23341, pp 3) **Analysis of planetary evolution with emphasis on differentiation and dynamics.** Kaula, W.M.; Newman, W.I. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

In order to address the early stages of nebula evolution, a three-dimensional collapse code which includes not only hydrodynamics and radiative transfer, but also the effects of ionization and, possibly, magnetic fields is being addressed. As part of the examination of solar system evolution, an N-body code was developed which describes the latter stages of planet formation from the accretion of planetesimals. To test the code for accuracy and run-time efficiency, and to develop a stronger theoretical foundation, problems were studied in orbital dynamics. A regional analysis of the correlation in the gravity and topography fields of Venus was performed in order to determine the small and intermediate scale subsurface structure.

44283 (N—87-23341, pp 1) **Evolution of planetesimal velocities.** Stewart, G.R.; Wetherill, G.W. (Carnegie Institution of Washington, DC). May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

A self-consistent set of equations for the velocity evolution of a general planetesimal population is presented. The equations are given in a form convenient for calculations of the early stages of planetary accumulation when it is necessary to model the planetesimal swarm by methods of gas dynamics, rather than follow the orbital evolution of individual bodies. Steady state velocities of a simple planetesimal population consisting of two different sizes of bodies are calculated. Dynamical friction is found to be an important mechanism for transferring kinetic energy from the larger planetesimals to the smaller ones. When the small planetesimals are relatively abundant, gas drag and inelastic collisions among the smaller bodies are of comparable importance for dissipating energy from the population.

44284 (N—87-23341, pp 2) **Accumulation of solid bodies in the solar nebula.** Weidenschilling, S.J.; Davis, D.R. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

Research on the accumulation of solid bodies in the solar nebula is discussed. Studies of the earliest stage of accumulation of solid bodies in the solar system, which occured in the presence of the gaseous component of the solar nebula, are discussed. The combined effects of gas drag and gravitational perturbations of a planetary embryo on the orbital evolution of planetesimals, the effects of resonant trapping on planetesimals, and planetary mass accretion are discussed.

44285 (N—87-23341, pp 1) **Scaling law for accretion zone sizes.** Greenzweig, Y.; Lissauer, J.J. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

Current theories of runaway planetary accretion require small random velocities of the accreted particles. Two body gravitational accretion cross sections which ignore tidal perturbations of the Sun are not valid for the slow encounters which occur at low relative velocities. Wetherill and Cox have studied accretion cross sections for rocky protoplanets orbiting at 1 AU. Using analytic methods based on Hill's lunar theory, one can scale these results for protoplanets that occupy the same fraction of their Hill sphere as does a rocky body at 1 AU. Generalization to bodies of different sizes is achieved here by numerical integrations of the three-body problem. Starting at initial positions far from the accreting body, test particles are allowed to encounter the body once, and the cross section is computed. A power law is found relating the cross section to the radius of the accreting body (of fixed mass).

44286 (N—87-23341, pp 3) **Collisional and dynamical processes in moon and planet formation.** Chapman, C.R.; Davis, D.R.; Weidenschilling, S.J.; Hartmann, W.K.; Spaute, D. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

Research on a variety of dynamical processes relevant to the formation of planets, satellites and ring systems is discussed. The main focus is on studies of accretionary formation of early protoplanets using a numerical model, structures and evolution of ring systems and individual bodies within planetary rings, and theories of lunar origin.

44287 (N—87-23341, pp 1) **Dynamical constraints on the origin of the moon.** Boss, A.P.; Peale, S.J. (California Univ., Santa Barbara). May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

Six different categories of models for the formation of the moon within the context of the general theory of terrestial planet formation by the accumulation of protoplanets are discussed. These catagories are: (1) rotational fission; (2) precipitation fission; (3) intact capture; (4) disintegrative capture; (5) binary accretion; and (6) giant impact accretion. It appears that the only plausable mechanism proposed thus far involves the formation of the Moon fol-

lowing a giant impact that ejects portions of the differentiated Earth's mantle and parts of the impacting body into circumterrestrial orbit.

44288 (N—87-23341, pp 1) **Lunar science from lunar laser ranging.** Williams, J.G.; Newhall, X.X.; Dickey, J.O. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

Seventeen years of lunar ranging data have been analyzed to determine lunar second-degree moment differences, third-degree gravitational harmonics, Love number, rotational dissipation and retroreflector coordinates.

44289 (N—87-23341, pp 3) **Solar system dynamics.** Wisdom, J. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

The rotational dynamics of irregularly shaped satellites and the origin of Kirkwood Gaps are discussed. The chaotic tumbling of Hyperion and the anomalously low eccentricity of Deimos are examined. The Digital Orrery is used to explore the phase space of the ellipic restricted three body problem near the principal commensurabilities (2/1, 5/2, 3/1, and 3/2). The results for the 3/1 commensurability are in close agreement with those found earlier with the algebraic mapping method. Large chaotic zones are associated with the 3/1, 2/1 and 5/2 resonances, where there are gaps in the distribution of asteroids. The region near the 3/2 resonance, where the Hilda group of asteroids is located, is largely devoid of chaotic behavior. Thus, there is a qualitative agreement between the character of the motion and the distribution of asteroids.

44290 (N—87-23341, pp 3) **Dynamics of satellites, asteroids, and rings.** Dermott, S.F. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

Work is reported on: (1) the shapes and the internal structures of satellites; (2) the tidal heating of Miranda; (3) the dynamics of arc-like rings; and (4) the structure of the zodiacal cloud that was revealed by the Infrared Astronomy Satellite. Significant progress was made in determining the shape and internal structure of Mimas and in understanding the dynamical evolution of Miranda's orbit.

44291 (N—87-23341, pp 1) **Hamiltonian theory of nonlinear waves in planetary rings.** Stewart, G.R. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

The derivation of a Hamiltonian field theory for nonlinear density waves in Saturn's rings is discussed. Starting with a Hamiltonian for a discrete system of gravitating streamlines, an averaged Hamiltonian is obtained by successive applications of Lie transforms. The transformation may be carried out to any desired order in q, where q is the nonlinearity parameter defined in the work of Shu, et al (1985) and Borderies et al (1985). Subsequent application of the Wentzel-Kramer-Brillouin Method approximation yields an asymptotic field Hamiltonian. Both the nonlinear dispersion relation and the wave action transport equation are easily derived from the corresponding Lagrangian by the standard variational principle.

44292 (N—87-23341, pp 3) **Planetary ring dynamics and morphology.** Cuzzi, J.N.; Durisen, R.H.; Shu, F.H. (California Univ., Berkeley). May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

Evidence for a moonlet belt in the region between Saturn's close-in moonrings Pandora and Prometheus is discussed. It is argued that little-known observations of magnetospheric electron density by Pioneer 11 imply substantial, ongoing injections of mass into the 2000 km region which surrounds the F ring. A hypothesis is presented that these events result naturally from interparticle collisions between the smaller members of an optically thin belt of moonlets. Also discussed is work on Uranus ring structure and photometry, image processing and analysis of the Jonian ring strucure, photometric and structural studies of the A ring of Saturn, and improvements to an image processing system for ring studies.

44293 (N—87-23341, pp vp) **Experiments pertaining to the formation and equilibration of planetary cores.** Jeanloz, R.; Knittle, E.; Williams, Q. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

The phase diagram of FeO was experimentally determined to pressures of 155 GPa and temperatures of 4000 K using shock wave and diamond-cell techniques. Researchers discovered a metallic phase of FeO at pressures greater than 70 GPa and temperatures exceeding 1000 K. The metallization of FeO at high pressures implies that oxygen can be present as the light alloying element of the Earth's outer core, in accord with the geochemical predictions of Ringwood. The high pressures necessry for this metallization suggest that the core has acquired its composition well after the initial stages of the Earth's accretion. The core forming alloy can react chemically with oxides such as those forming the mantle. The core and mantle may never have reached complete chemical equilibrium, however. If this is the case, the core-mantle boundary is likely to be a zone of active chemical reactions.

44294 (N—87-23341, pp 3) **Properties of planetary fluids at high pressure and temperature.** Nellis, W.J.; Hamilton, D.C.; Holmes, N.C.; Radousky, H.B.; Ree, F.H.; Ross, M.; Young, D.A.; Nicol, M. (California Univ., Los Angeles). May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

In order to derive models of the interiors of Uranus, Neptune, Jupiter and Saturn, researchers studied equations of state and electrical conductivities of molecules at high dynamic pressures and temperatures. Results are given for shock temperature measurements of N_2 and CH_4. Temperature data allowed demonstration of shock induced cooling in the the transition region and the existence of crossing isotherms in P-V space.

44295 (N—87-23341, pp 3) **Gravity data analysis.** Sjogren, W.L. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

Work on three different efforts related to gravity data analysis is discussed. The reduction of raw Doppler data from the Apollo 15 subsatellite to produce acceleration profiles as a function of latitude, longitude and altitude; an investigation related to fitting long arcs of Pioneer Venus Orbiter tracking data; and a study of gravity/topography ratios which were found to have a linear trend with longitude are discussed.

44296 (N—87-23341, pp 1) **Origin of polarity asymmetries in the history of the geomagnetic field.** Levy, E.H. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

The behavior of magnetohydrodynamic stationary modes in the presence of an imposed weak magnetic field originating separately from the dynamo is studied. A rare class of stationary states is found that exhibit high sensitivity to the presence of weak imposed fields. The amplitude of the difference between the total fields of opposite polarity is much larger than the amplitude of the imposed nondynamo fields. It is proposed that Earth's magnetic field operates in such a mode, highly sensitive to the presence of an ambient field. An argument is given to explain why the terrestrial dynamo should choose to operate in one of these rare states. Implications are discussed for the general mechanism of dynamo magnetic field equilibrium in planets.

44297 (N—87-23341, pp 1) **Magnetic flares in the protoplanetary nebula and the origin of meteorite chondrules.** Levy, E.H.; Araki, S. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

This study proposes and analyzes a model for the chondrule forming heating events based on magnetohydrodynamic flares in the corona of the protoplanetary nebula which precipitate energy in the form of energetic plasma along magnetic field lines down toward the face of the nebula. It is found that flare energy release rates sufficient to melt the prechondrular matter, leading to the formation of the chondrules, can occur in the tenuous corona of a protostellar disk. Energy release rates sufficient to achieve melting require that the ambient magnetic field strength be in the range that has been inferred separately from independent meteorite remanent magnetization studies.

44298 (N—87-23341, pp 1) **Generation of a dynamo magnetic field in a protoplanetary accretion disk.** Stepinski, T.; Levy, E.H. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

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A new computational technique is developed that allows realistic calculations of dynamo magnetic field generation in disk geometries corresponding to protoplanetary and protostellar accretion disks. The approach is of sufficient generality to allow, in the future, a wide class of accretion disk problems to be solved. Here, basic modes of a disk dynamo are calculated. Spatially localized oscillatory states are found to occur in Keplerain disks. A physical interpretation is given that argues that spatially localized fields of the type found in these calculations constitute the basic modes of a Keplerian disk dynamo.

44299 (N—87-23341, pp 1) **Implications of convection in the Moon and the terrestrial planets.** Turcotte, D.L. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

The early thermal and chemical evolution of the Moon is discussed. The rubidium-strontium, neodymium-samarium, and uranium-thorium-lead systems were studied. The relation of source region heterogeneity to the mixing associated with mantle convection is considered. Work on the application of fractal concepts to planetary geology and geophysics is also discussed. The fractal concept was applied to fragmentation, including the frequency-size distribution of meteorites, asteroids and particulate matter produced by impacts.

44300 (N—87-23341, pp 1) **Case for a wet, warm climate on early Mars.** Pollack, J.B.; Kasting, J.F.; Richardson, S.M.; Poliakoff, K. (IMI, Inc., San Jose, CA). May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

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Arguments are presented in support of the idea that Mars possessed a dense CO_2 atmosphere and a wet, warm climate early in its history. The plausibility of a CO_2 greenhouse is tested by formulating a simple model of the CO_2 geochemical cycle on early Mars. By scaling the rate of silicate weathering on Earth, researchers estimated a weathering time constant of the order of several times 10 to the 7th power years for early Mars. Thus, a dense atmosphere could have existed for a geologically significant time period (approx. 10 to the 9th power years) only if atmospheric CO_2 was being continuously resupplied. The most likely mechanism by which this could have been accomplished is the thermal decomposition of carbonate rocks induced directly or indirectly by intense, global scale volcanism.

44301 (N—87-23341, pp 3) **Variations of Martian surface albedo: Evidence for yearly dust deposition and removal.** Christensen, P.R. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

The purpose is to determine the degree, spatial distribution and timing of the deposition and removal of dust storm fallout, and to relate the current patterns of dust deposition and removal to the long-term evolution of the Martian surface. Southern Hemisphere dark areas are found to quickly return to close to their pre-storm albedos, suggesting rapid removal of any dust that was deposited. Northern Hemisphere dark regions are brighter post-storm, but gradually darken to pre-storm levels over the Mars year. In doing so they act as local sources of dust during otherwise clear periods. Dust does not appear to be removed from bright regions, resulting in the 1 to 2 m thick deposits observed today.

44302 (N—87-23341, pp 2) **Gossans on Mars: spectral features attributed to jarosite.** Burns, R.G. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

Jarosites, which are present in terrestrial gossans capping oxidized sulfides associated with mafic igneous rocks, may also be present in Martian regolith. Spectral characteristics of jarosites are displayed in remote sensed reflectance spectra of bright regions of Mars surface. The occurrence of jarosite in the regolith would imply that acidic permafrost and sulfide ores exist beneath the surface of Mars.

44303 (N—87-23341, pp 3) **Characterization of surficial units on Mars using Viking orbiter multispectral image and thermal data.** Presley, M.A.; Arvidson, R.E.; Christensen, P.R. (Arizona State Univ., Tempe). May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

Albedo and thermal property correlations of the topography of Mars were conducted with emphases upon the types and origins of materials exposed in the central equatorial region. This area displays a wide variation in color, albedo and thermal properties, and is relatively free of dust and haze. The physical, mineralogical and elemental characteristics of this area are discussed.

44304 (N—87-23341, pp 3) **Investigation of Martian H_2O and CO_2 via gamma-ray spectroscopy.** Squyres, S.W.; Evans, L.G. (Computer Sciences Corp., Beltsville, MD). May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

The evolution and present state of water and carbon dioxide on Mars are discussed. Researchers wished to determine how effectively questions regarding the distribution of water and carbon dioxide on Mars may be addressed with orbital gamma ray spectrometer data. Several simple, multi-layer models of the Martian surface were formulated to address problems such as the ice/dust ratio of layered deposits; the distribution, depth and concentration of ground ice; the thickness of north polar perennial ice; the thickness of the carbon dioxide layer over the south polar cap; the thickness of the seasonal carbon dioxide frost cap; and the water content of the seasonal frost cap. The results indicate that the Mars Observer gamma ray spectrometer will be a powerful tool for investigating the distribution and stratigraphy of volatiles on Mars.

44305 (N—87-23341, pp 3) **Reflectance spectra of mafic silicates and phyllosilicates from .6 to 4.6 microns.** Roush, T.L.; Singer, R.B.; Mccord, T.B. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

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The results of spectral measurements for mafic silicates are given. The study provided valuable spectral reflectance information about mafic silicates and phyllosilicates in the 2.5 to 4.6 micron wavelength region. It was shown that the reflectance of these materials is strongly affected by the presence of H_2O and OH. Therefore, the identification of these absorbing species is greatly enhanced.

44306 (N—87-23341, pp 3) **Mid-infrared spectroscopic investigation.** Walter, L.; Vergo, N.; Salisbury, J.W. (Geological Survey, Denver, CO). May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

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Mid-infrared spectroscopic research efforts are discussed. The development of a new instrumentation to permit advanced measurements in the mid-infrared region of the spectrum, the development of a special library of well-characterized mineral and rock specimens for interpretation of remote sensing data, and cooperative measurements of the spectral signatures of analogues of materials that may be present on the surfaces of asteroids, planets or their Moons are discussed.

44307 (N—87-23341, pp 3) **Thermal-infrared spectral observations of geologic materials in emission.** Christensen, P.R.; Luth, S.J. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

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The thermal-infrared spectra of geologic materials in emission were studied using the prototype Thermal Emission Spectrometer (TES). A variety of of processes and surface modifications that may influence or alter the spectra of primary rock materials were studied. It was confirmed that thermal emission spectra contain the same absorption features as those observed in transmission and reflection spectra. It was confirmed that the TES instrument can be used to obtain relevant spectra for analysis of rock and mineral composition.

44308 (N—87-23341, pp 1) **Atlas of reflectance spectra of terrestrial, lunar and meteoritic powders and frosts from 92 to 1800 lc2)nm.** Wagner, J.; Hapke, B.; Wells, E. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

The reflectance spectra of powdered samples of selected minerals, meteorites, lunar materials and frosts are presented as an aid in the interpretation of present and future remote sensing data of solar system objects. Spectra obtained in separate wavelength regions have been combined and normalized, yielding coverage from 92 to 1800 nm. Spectral features include reflectance maxima in the far UV region produced by valence-conduction interband transitions, and reflectance minima in the near UV, visible and near IR regions, produced by charge transfer and crystal field transitions. Specific maxima and minima are diagnostic of mineral type and composition; additionally, the minerals present in mixtures such as meteorites and lunar samples can be determined.

44309 (N—87-23341, pp 2) **Compositional information for the Moon: Some characteristics of current near-IR spectra (telescopic and laboratory).** Pieters, C.M. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

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For the last decade telescopic near infrared spectra have been obtained for small lunar areas. Such spectra, with the ground truth foundation from lunar samples, have been used extensively to address a multitude of problems in lunar science. Much of the near infrared spectral reflectance data from both laboratory and telescopic measurements have recently been compiled in comparable formats and an initial comparative assessment of the available data using selected spectral parameters has been made. The objective is to develop a framework for the systematics of lunar near-IR spectra in order to better interpret spectra of unknown materials in terms of useful compositional information. Each spectrum was first classified according to its general character then a variety of parameters sensitive to mineralogy and alteration products were measured for each spectrum: band width, band strength, absorption band center near 1 micron, band symmetry, continuum slope, etc. The telescopic and laboratory data sets are briefly described. The comparative analysis shows that a few well known lunar spectral properties are evident in both sets, such as the systematic variation in pyroxene composition between the highlands and the mare. However, an additional gabbroic component can be detected in many highland craters.

44310 (N—87-23341, pp 3) **Preliminary results of spectral reflectance studies of tycho crater.** Hawke, B.R.; Coombs, C.R.; Lucey, P.G.; Bell, J.F.; Jaumann, R.; Neukum, G.; Pieters, C.M. (Brown Univ., Providence, RI). May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

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The preliminary analysis and interpretation of near infrared spectra obtained for both the interior and exterior deposits associated with the Tycho crater is presented. Specific objectives were: (1) to determine the composition and stratigraphy of the highland crust in the Tycho target site; (2) to determine the likely composition of the primary ejecta which may be present in ray deposits; (3) to investigate the nature of spectral units defined in previous studies; (4) to further investigate the nature and origin of both the bright and dark haloes around the rim crest; and (5) to compare the compositions determined for the Tycho units with those of the Aristarchus crater as well as typical highland deposits. The spectra obtained for the interior areas exhibit similar spectral features. These include relatively strong 1 micron absorption bands whose minima are centered between 0.97 and 0.99 microns and shallow to intermediate continuum slopes. The spectra generally exhibit indications of a 1.3 micron feature consistent with the presence of Fe(2+) bearing plagioclase feldspar. The strong 1 micron absorption features indicate a dominant high Ca clinopyroxene component. Results obtained from the ejecta deposits show that the spectrum of the inner, bright halo is almost identical with those obtained for interior units. The spectrum of the dark halo exhibits a wide, relatively shallow absorption feature centered at 1.01 microns, a 1.3 micron absorption, and a steep continuum slope. This spectrum is interpreted as indicating the presence of pyroxene, Fe-bearing feldspar, and a significant component of Fe-bearing impact melt glass. Finally, the spectra of spots inside Tycho show similarity with certain spectra for Aristarchus. However, the suite of spectra obtained for Tycho exhibits a different trend in terms of band center versus width.

44311 (N—87-23341, pp 3) **Preliminary results of geologic and remote sensing studies of Rima Mozart.** Coombs, C.R.; Hawke, B.R. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

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In order to better understand the processes responsible for the formation of lunar sinuous rilles, a study of Rima Mozart was conducted using a variety of geologic, photographic, and remote sensing data. The apparent source of this rille is located in a highlands unit of known composition and it is hypothesized that thermal and mechanical erosion played an important role in the formation of Rima Mozart. Excellent photographic, topographic, multispectral, and radar data exist for this rille. The preliminary results of an analysis of this data are presented. Photographic data indicates the presence of two volcanic source vents for Rima Mozart: Kathleen and Ann. It is suggested that Rima Mozart, like many other lunar sinuous rilles, was most likely formed by a combination of events. Rima Mozart does follow a pre-existing, dominant NW/SE structural trend suggesting the influence of structural features on the rille, however, the tectonic influence is not the sole source for the formation of the rille, as suggested by the presence of the two source vents and the spatter around Ann. It is suggested that the rille formation began with an explosive eruption at Kathleen which later calmed down to a pulsating, high volume, low-viscosity lava flow. The rapid effusion rate of the magma as well as its high temperature and turbid nature helped carve the sinuous rille into the fractured and structurally weak Apennine Bench Formation underneath. Similar eruptions and subsequent flows were also created at Ann and joined to the main channel by a NE-trending secondary rille.

44312 (N—87-23341, pp 1) **Sputter alteration of regoliths of outer solar system bodies.** Hapke, B. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

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Several processes that are expected to occur when the porous regoliths of outer solar system bodies (without atmospheres) are subjected to energetic ion bombardment are discussed. The conclusions reached in much of the literature addressing sputtering are quantitatively or qualitatively incorrect because effects of soil porosity have been neglected. It is shown theoretically and experimentally that porosity reduces the effective sputtering yield of a soil by more than an order of magnitude. Between 90 and 97% of the sputtered atoms are trapped within the regolith, where they are factionated by differential desorption. Experiments indicate that more volatile species have higher desorption probabilities. This process is the most important way in which alteration of chemical and optical properties occurs when a regolith is sputtered. When a basic silicate soil is irradiated these effects lead to sputter-deposited films enriched in metallic iron, while O, Na and K are preferentially lost. The Na and K are present in the atmosphere above the sputtered silicate in quantities much greater than their abundances in the regolith. Icy regoliths of SO_2 should be enriched in elemental S and/or S_2O. This prediction is supported by the probable identification of S_2O and polysulfur oxide bands in the IR spectra of H-sputtered SO_2 reported by Moore. When porous mixtures of water, ammonia and methane frosts are sputtered, the loss of H and surface reactions of C, N and O in the deposits should produce complex hydrocarbons and carbohydrates, some of which may be quite dark. Such reactions may have played a role in the formation of the matrix material of carbonaceous chondrites prior to agglomeration.

44313 (N—87-23341, pp 2) **Charged particle modification of surfaces in the outer solar system.** Johnson, R.E. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

Voyager reflectance spectra data have indicated clear leading/trailing differences in the albedo of the icy Galilean and Saturian satellites. For the Galilean satellites, these have been analyzed by Nelson, et al. and, more recently, by McEwen. They have described the longitudinal dependence of this data and attempted to interpret this in terms of plasma and meteorite modification of the surface. Primary attention has been paid to Europa at which the leading/trailing differences are the largest. This data was reanalyzed extracting the single grain albedo (w) and constructing the Espat-function, W = (1-w)/w from this. Because w is near unity, W is approximately 2(alpha)D where alpha is the absorption coefficient and D is the grain size. In doing so, a direct comparison to the longitudinal plasma bombardment flux was found for the first time. This occurs primarily in the UV and is probably due to an absorption associated with implanted S, as the UV band of Voyager overlaps the IUE data of Lane et al. The relative importance of grain size effects and implant impurity effects can now be studied.

44314 (N—87-23341, pp 1) **Sulfur-oxygen processes on Io.** Nelson, R.M.; Smythe, W.D. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

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Laboratory studies of irradiated sulfur dioxide frost have found that sulfur trioxide should be formed as a consequence of the irradiation process. The spectral reflectance of solid sulfur trioxide was measured in the laboratory and it was found that the compound has strong absorption features at 3.37 and 3.70 microns. These features are not present in the spectral geometric albedo of Io. This is interpreted as an indication that sulfur trioxide may exist in such limited abundance that it is undetectable in disk averaged spectrophotometry. It is suggested that the Near-Infrared Mapping Spectrometer on the Galileo spacecraft should be able to identify condensed sulfur trioxide on Io particularly in regions bordering the sulfur dioxide deposits. The presence of elemental sulfur on Io's surface has been questioned on several grounds, most notably the suggested production process (quenched molten sulfur extrusions) and the effect of radiation (particularly x rays) on some of the allotropes. Mixtures of sulfur allotropes were produced in the laboratory by quenching molten sulfur and it was found that the spectra indicate the presence of certain red-colored allotropes which are preserved upon quenching. The color of the sulfur glass produced is redder when the temperature of the original melt is higher. This is consistent with the suggestion that Io's spectral geometric albedo can be partly explained by the presence of quenched sulfur glasses.

44315 (N—87-23341, pp 1) **Preliminary analysis of the Mariner 10 color ratio map of Mercury.** Rava, B.; Hapke, B. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

A preliminary geological analysis of the Mariner 10 orange/UV color ratio map of Mercury is given, assuming a basaltic crust. Certain errors in the map are pointed out. The relationship between color and terrain are distinctly non-lunar. Rays and ejecta are bluer than average on Mercury, whereas they are redder on the Moon. This fact, along with the lack of the ferrous band in Mercury's spectral reflectance and smaller albedo contrasts, implies that the crust is low in Fe and Ti. There is no correlation between color boundaries and the smooth plains on Mercury, in contrast with the strong correlation between color and maria-highlands contacts on the Moon. The smooth plains are not Mercurian analogs of lunar maria, and a lunar-type of second wave melting did not occur. Ambiguous correlations between color and topography indicate that older, redder materials underlie younger, bluer rocks in many places on the planet, implying that the last stages of volcanism involved low-Fe lavas covering higher-Fe rocks. There is some evidence of late Fe-rich pyroclastic activity.

44316 (N—87-23341, pp 2) **Regional sources and sinks of dust on Mars: Viking observations of Cerberus, Solis Planum and Syrtis Major.** Lee, S.W. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

A study of seasonal variations of albedo features in the Cerberus, Solis Planum, and Syrtis Major regions was based on Viking Orbiter data obtained over more than one complete Martian year. Contour maps of Lambert albedo and single-point thermal inertia were constructed from the Infrared Thermal Mapper (IRTM) experiment data, and Orbiter images were used to determine the pattern and variability of regional winds (inferred from wind streak orientations). Coupled with ground-based radar data, these data allow the regional sediment transport direction, surface properties (texture, morphology, and roughness), and the implications of the observed seasonal and longer term dust redistribution to be investigated. Results are outlined.

44317 (N—87-23341, pp 3) **High resolution thermal infrared mapping of Martian channels.** Craddock, R.A.; Greeley, R.; Christensen, P.R. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

Viking Infrared Thermal Mapper (IRTM) high resolution (2 to 5 km) data were compiled and compared to Viking Visual Imaging Subsystem (VIS) data and available 1:5M geologic maps for several Martian channels including Dao, Harmakhis, Mangala, Shalbatana, and Simud Valles in an effort to determine the surface characteristics and the processes active during and after the formation of these channels. Results show a dominance of aeolian processes active in and around the channels. These processes have left materials thick enough to mask any genuine channel deposits. Results also indicate that very comparable Martian channels and their surrounding terrain are blanketed by deposits which are homogeneous in their thermal inertia values. However, optimum IRTM data does not cover the entire Martian surface and because local deposits of high thermal inertia material may not be large enough in areal extent or may be in an unfavorable location on the planet, a high resolution data track may not always occur over these deposits. Therefore, aeolian processes may be even more active than the IRTM data tracts can always show.

44318 (N—87-23341, pp 3) **Eolian saltation on Mars.** Mackinnon, D.J. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

A computer model was developed in order to examine the effects of the wind field and surface collisions on the Martian saltation cloud. The distribution of incidence speeds and angles assumed by one grain in this model characterizes reasonably well the quantitative physical processes in the saltation cloud. Saltating grains that transfer small fractions of their horizontal momentum to the surface attain higher speeds, rise higher above the surface, and achieve longer trajectories than do saltating grains that transfer larger amounts of momentum; relatively small differences in the coefficients of restitution yield significant differences in the saltation cloud. It is also shown that grains can both assume long trajectories and transfer large amounts of momentum to the surface for the rapid development of the saltation cloud.

44319 (N—87-23341, pp 2) **Mass transport by Aeolian saltation on Earth, Mars and Venus: The effects of full saltation cloud development and choking.** Williams, S.H.; Greeley, R. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

Wind tunnel tests were conducted to study the characteristics of particle motion and the quantity transported by wind under a variety of planetary environmental conditions. Analysis of the results indicates that, on Earth, saltation fully develops at near-threshold wind speeds and rarely chokes (retarding of saltation due to high particle concentration and subsequent increase of mid-air collisions). On Mars, saltation becomes fully developed only at favorable locations and at wind speeds well above threshold. The Martian saltation cloud has an insufficient particle concentration to cause choking, particularly over a partially rocky surface. On Venus, full saltation occurs at wind speeds very near threshold, but saltation flux increases less rapidly than expected at relatively modest wind speeds due to choking.

44320 (N—87-23341, pp 3) **Fluvial valleys on Martian volcanoes.** Baker, V.R.; Gulick, V.C. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

Channels and valleys were known on the Martian volcanoes since their discovery by the Mariner 9 mission. Their analysis has generally centered on interpretation of possible origins by fluvial, lava, or viscous flows. The possible fluvial dissection of Martian volcanoes has received scant attention in comparison to that afforded outflow, runoff, and fretted channels. Photointerpretative, mapping, and morphometric studies of three Martian volcanoes were initiated: Ceraunius Tholus, Hecate Tholus, and Alba Patera. Preliminary morphometric results indicate that, for these three volcanoes, valley junction angles increase with decreasing slope. Drainage densities are quite variable, apparently reflecting complex interactions in the landscape-forming factors described. Ages of the Martian volcanoes were recently reinterpreted. This refined dating provides a time sequence in which to evaluate the degradational forms. An anomaly has appeared from the initial study: fluvial valleys seem to be present on some Martian volcanoes, but not on others of the same age. Volcanic surfaces characterized only by high permeability lava flows may have persisted without fluvial dissection.

44321 (N—87-23341, pp 3) **Valley development on Hawaiian volcanoes.** Baker, V.R.; Gulick, V.C. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

Work in progress on Hawaiian drainage evolution indicates an important potential for understanding drainage development on Mars. Similar to Mars, the Hawaiian valleys were initiated by surface runoff, subsequently enlarged by groundwater sapping, and eventually stabilized as aquifers were depleted. Quantitative geomorphic measurements were used to evaluate the following factors in Hawaiian drainage evolution: climate, stream processes, and time. In comparing regions of similar climate, drainage density shows a general increase with the age of the volcani island. With age and climate held constant, sapping dominated valleys, in contrast to runoff-dominated valleys, display the following: lower drainage densities, higher ratios of valley floor width to valley height, and more positive profile concavities. Studies of stream junction angles indicate increasing junction angles with time on the drier leeward sides of the major islands. The quantitative geomorphic studies and earlier field work yielded important insights for Martian geomorphology. The importance of ash mantling in controlling infiltration on Hawaii also seems to apply to Mars. The Hawaiian valley also have implications for the valley networks of Martian heavily cratered terrains.

44322 (N—87-23341, pp 2) **Possible origin of some channels on Alba Patera, Mars.** Postawko, S.E.; Mouginis-mark, P. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

Several alternative models were proposed for the origin and mode of formation of channels and valley networks on Martian volcanoes, notably Hecates Tholus, Ceraunius Tholus, and Alba Patera. Early interpretations of Mariner 9 and Viking images suggested that these features on Alba were lava channels, while those on Ceraunius Tholus were interpreted as fluvial or volcanic debris channels. Subsequent mapping of Tyrrehna Patera and Hecate Tholus has suggested that pyroclastic activity may have characterized eruptions on these volcanoes, and that at least for Hecates the channels were probably formed by fluvial erosion of unconsolidated ash deposits on the flanks of the volcano. As part of a continuing program to better understand the eruptive history of the young volcanic centers on Mars, numerous channels were identified on the flanks of Alba Patera that resemble the channels on Hecates. As a result, the possibility is being explored that some of the small channels on the flanks of Alba Patera may be fluvial in origin and potentail water sources and modes of formation are being explored.

44323 (N—87-23341, pp 3) **Volatile reservoirs below the surface of the Elysium region of Mars: geomorphic evidence.** Christiansen, E.H.; Hopler, J.A. (Iowa Univ., Iowa City). May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

The Elysium volcanic province contains a variety of geomorphic evidence for the existence of large volatile reservoirs of subsurface volatiles. Study of these landforms yields insight into the distribution and size of these reservoirs and how they interact with the surface environment and will ultimately place constraints on the geometry, constitution, origin, time of formation, and temporal evolution of these important components of the Martian crust. Three principal types of landforms appear to be related to subsurface volatile reservoirs in the Elysium region of Mars: small outflow channels; large lahars; and vast expanses of knobby terranes around the margins of the Elysium dome. The evidence provided by these landforms is internally consistent with the presence of a large relatively shallow volatile reservoir in the Elysium region. If the geologic features described are reliable indicators of subsurface volatiles, they imply that: volatile reservoirs lie relatively close to the surface and underlie millions of sq km in this region; there is no apparent latitudinal variation in the depth or thickness of the volatile reservoirs; the precursors of the knobby terranes are or were important volatile reservoirs; volatiles may be lost in a variety of ways from these reservoirs; and volatiles were incorporated in an easily eroded surficial deposit in the middle history of Mars. The ultimate origin of water in this reservoir is uncertain. A model to explain the preferential entrapment of volatiles into the region's surface materials may be required.

44324 (N—87-23341, pp 3) **Evidence for glaciation in Elysium.** Anderson, D.M. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

Evidence for the existence of permafrost and the surface modification due to frost effects and the presence of ice on Mars dates from early observations. Later analysis of the Viking Orbiter

imagery produced evidence suggesting the former presence of ice sheets that could have played a part in shaping the surface of Mars. Similarities were pointed out between a number of streamlined Martian channel features and similar streamlined landforms created by Antarctic ice sheet movement. A study of Viking Orbiter imagery of Granicus Valles and the surrounding terrain in Elysium has produced further evidence of glaciation on Mars. Volcanism has played an important role in developing the landscapes of the Elysium region. A possible explanation is that subsidence occurred during formation of the Martian moberg ridges due to the melting of ground ice near the eruption area while at a distance most of the ground ice in the permafrost is still present and the original elevation was preserved. Meltwater during and following eruptions might be suddenly released during subglacial volcanism into Granicus Valles in one case and into Hrad Valles in the other. Fluvial erosion thus could have played a role in shaping both.

44325 (N—87-23341, pp 3) **Formation of the layered deposits in the Valles Marineris, Mars.** Nedell, S.S.; Squyres, S.W. (Cornell Univ., Ithaca, NY). May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

Thick sequences of layered deposits are found in the Valles Marineris, which exhibit fine, nearly horizontal layering, and are present as isolated plateaus of what were once more extensive deposits. It was argued that the morphology of the deposits is most consistent with origin in standing bodies of water. The conditions necessary for the existence of ice-covered Martian paleolakes are examined in detail and mechanisms for sediment deposition in them are considered. It was concluded that there are several geologically feasible mechanisms that could have led to the formation of thick deposits in ice-covered paleolakes in the Valles Marineris. Present data are insufficient to choose conclusively among the various possibilities. Several types of data from the Mars Observer mission will be useful in further characterizing the deposits and clarifying the process of their origin. The deposits should be considered important targets for a future Mars sample return mission.

44326 (N—87-23341, pp 3) **Explosive volcanic deposits on Mars: preliminary investigations.** Crown, D.A.; Leshin, L.A.; Greeley, R. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

Two investigations were undertaken to examine possible large scale explosive volcanic deposits on Mars. The first includes an analysis of Viking Infrared Thermal Mapper (IRTM) data covering the vast deposits in the Amazonis, Memnonia, and Aeolis regions. These postulated ignimbrites have been previously mapped, and at least five high resolution nighttime IRTM data tracks cross the deposits. Preliminary analysis of the data covering Amazonis Planitia show that local features have anomalous thermal inertias but the ignimbrites as a whole do not consistently have significantly different thermal inertias from their surroundings. Preliminary photogeologic and IRTM studies of the large and small highland paterae have also begun. The purpose of IRTM studies of postulated Martian explosive volcanic deposits is to determine the physical properties of the proposed ignimbrites. If volcanic deposits are exposed at the surface, high thermal inertias, as are observed for Apollinaris Patera, should be present.

44327 (N—87-23341, pp 3) **Pseudocraters as indicators of ground ice on Mars.** Frey, H. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

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Positive identification of Martian pseudocraters would be a strong indication of past occurrence of ice at or near the surface of Mars. The basis for suggesting that small cones on Mars are pseudocraters includes: (1) small size, (2) abundant but patchy distribution on what appear to be volcanic plains, (3) presence of other features suggestive of surface or subsurface ice, (4) morphological similarities to Icelandic pseudocraters, and (5) the similarity in distribution of crater/cone diameter ratios to Icelandic pseudocraters. This last morphometric parameter may be the most important, since other possible small terrestrial volcanic analogs have very different crater/cone diameter ratio distributions. In a survey of the available high resolution Viking Orbiter imagery, abundant fields of possible pseudocraters were found. However, only a small fraction of the plains forming units imaged at high resolution were found to contain the small cones. This low discovery rate, combined with the limited high resolution imagery, restrict Martian pseudocraters as global indicators of surface or subsurface ice. The meanings of this terrain analysis are discussed.

44328 (N—87-23341, pp 3) **Eruptive history of the Elysium volcanic province of Mars.** Tanaka, K.L.; Scott, D.H. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

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New geologic mapping of the Elysium volcanic province at 1:2,000,000 scale and crater counts provide a basis for describing its overall eruptive history. Four stages are listed and described in order of their relative age. They are also distinguished by eruption style and location. Stage 1: Central volcanism at Hecates and Albor Tholi. Stage 2: Shield and complex volcanism at Elysium Mons and Elysium Fossae. Stage 3: Rille volcanism at Elysium Fossae and Utopia Planitia. Stage 4: Flood lava and pyroclastic eruptions at Hecates Tholus and Elysium Mons. Tectonic and channeling activity in the Elysium region is intimately associated with volcanism. Recent work indicates that isostatic uplift of Tharsis, loading by Elysium Mons, and flexural uplift of the Elysium rise produced the stresses responsible for the fracturing and wrinkle-ridge formation in the region. Coeval faulting and channel formation almost certainly occurred in the pertinent areas in Stages 2 to 4. Older faults east of the lava flows and channels on Hecates Tholus may be coeval with Stage 1.

44329 (N—87-23341, pp 3) **Relative ages of lava flows at Alba Patera, Mars.** Schneeberger, D.M.; Pieri, D.C. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

Many large lava flows on the flanks of Alba Patera are astonishing in their volume and length. As a suite, these flows suggest tremendously voluminous and sustained eruptions, and provide dimensional boundary conditions typically a factor of 100 larger than terrestrial flows. One of the most striking features associated with Alba Patera is the large, radially oriented lava flows that exhibit a variety of flow morphologies. These include sheet flows, tube fed and tube channel flows, and undifferentiated flows. Three groups of flows were studied; flows on the northwest flank, southeast flank, and the intracaldera region. The lava flows discussed probably were erupted as a group during the same major volcanic episode as suggested by the data presented. Absolute ages are poorly constrained for both the individual flows and shield, due in part to disagreement as to which absolute age curve is representative for Mars. A relative age sequence is implied but lacks precision due to the closeness of the size frequency curves.

44330 (N—87-23341, pp 3) **Martian volcanism: festoon-like ridges on terrestrial basalt flows and implications for Mars.** Theilig, E.; Greeley, R. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

The Fink and Fletcher, and Fink model was used to assess and compare flow rheology for two terrestrial basalt flows and one Martian flow with previous studies. Based on the morphologic similarities between the Martian flows and the Icelandic flows and knowledge of the emplacement of the terrestrial flows, the flows west of Arsia Mons are considered to have been emplaced as large sheet flows from basaltic flood style eruptions. Festoon ridges represent folding of the surface crust in the last stages of emplacement when viscosities would be high due to cooling. Alternatively, the lava may have had a high crystallinity or was erupted at low temperatures. In addition, increased compressive stress behind halted flow fronts or in ponded areas may have contributed to ridge formation.

44331 (N—87-23341, pp 3) **Studies of fluid instabilities in flows of lava and debris.** Fink, J.H. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

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At least two instabilities have been identified and utilized in lava flow studies: surface folding and gravity instability. Both lead to the development of regularly spaced structures on the surfaces of lava flows. The geometry of surface folds have been used to estimate the rheology of lava flows on other planets. One investigation's analysis assumed that lava flows have a temperature-dependent Newtonian rheology, and that the lava's viscosity decreased exponentially inward from the upper surface. The author reviews studies by other investigators on the analysis of surface folding, the analysis of Taylor instability in lava flows, and the effect of surface folding on debris flows.

44332 (N—87-23341, pp 3) **Long, paired A'A/Pahoehoe flows of Mauna Loa: Volcanological significance and insights they provide into volcano plumbing systems.** Rowland, S.K.; Walker, G.P.L. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

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The long lava flows of Mauna Loa, Hawaii have been cited as Earth's closed analogs to the large Martian flows. It is therefore important to understand the flow mechanics and characteristics of the Mauna Loa flows and to make use of these in an attempt to gain insights into Martian eruptive processes. Two fundamentally different kinds of long lava flows can be distinguished on Hawaiian volcanoes as in Martian flows. The two kinds may have identical initial viscosities, chemical compositions, flow lengths, and flow volumes, but their flow mechanisms and thermal energy budgets are radically different. One travels a distance set by the discharge rate as envisaged by Walker and Wadge, and the other travels a distance set mainly by the eruption duration and ground slope. In the Mauna Loa lavas, yield strength becomes an important flow morphology control only in the distal part of a'a lavas. The occurrence of paired flows on Mauna Loa yields insights into the internal plumbing systems of the volcano, and it is significant that all of the volume of the a'a flow must be stored in a magma chamber before eruption, while none of the volume of the pahoehoe needs to be so stored. Differentiation between the two kinds of flows on images of Martian volcanoes is possible and hence an improved understanding of these huge structures is acquired.

44333 (N—87-23341, pp 2) **Studies of vesicle distribution patterns in Hawaiian lavas.** Walker, G.P.L. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

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Basaltic lava flows are generally vesicular, and the broader facts relating to vesicle distribution have long been established; few studies have yet been made with a view to determining how and when vesicles form in the cooling history of the lava, explaining vesicle shape and size distribution, and gaining enough understanding to employ vesicles as a geological tool. Various avenues of approach exist by which one may seek to gain a better understanding of these ubiquitous structures and make a start towards developing a general theory, and three such avenues have recently been explored. One avenue involves the study of pipe vesicles; these are a well known feature of lava flows and are narrow pipes which occur near the base of many pahoehoe flow units. Another avenue of approach is that presented by the distinctive spongy pahoehoe facies of lava that is common in distal locations on Hawaiian volcanoes. A third avenue of approach is that of the study of gas blisters in lava. Gas blisters are voids, which can be as much as tens of meters wide, where the lava split along a vesicle-rich layer and the roof up-arched by gas pressure. These three avenues are briefly discussed.

44334 (N—87-23341, pp 3) **Crustal and subcrustal nodules in ejecta from Kilbourne Hole Maar, New Mexico.** Whitford-Stark, J.L. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

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Nodules retrieved from the ejecta of volcanic craters serve as the source of two major items of information. The first is in providing details of the geochemistry and mineralogy of the Earth's interior by supplying samples of materials that cannot be obtained by existing drilling techniques. The other is in providing information regarding the process which led to their transport from the Earth's interior to the surface. The primary purpose of the present study was to examine the morphology of the nodules in an attempt to place some constraints on the process that brought them to the surface. This attempt is briefly discussed.

44335 (N—87-23341, pp 3) **Geology of the Mohon Mountain volcanic field, Yavapai and Mohave Counties, Arizona: a preliminary report.** Simmons, A.M.; King, J.S. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

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Field mapping has produced a preliminary picture of Mohon Mountain as a composite volcano, in which pyroclastic ash and larger tephra erupted alternately with flows of rhyodacite and dacite. An analog study which uses imagery of lunar and Martian features will compare the overall shape of the vent complex, including its breached southern flank and satellite vents, to similar landforms found on Mars and the Moon which are believed to have formed similar processes. Ash flow sheets were hypothesized to comprise the outer slopes of Olympus Mons suggesting that explosive eruptions which are more volatile-rich than those which produce basalt flows are not confined to terrestrial settings but may also be found on bodies such as Mars, which have a thicker crust and deeper magma source in the mantle. The analog study will explore further evidence for explosive eruptions on Mars and the Moon.

44336 (N—87-23341, pp 3) **Geology of Pine and Crater Buttes: two basaltic constructs on the far eastern Snake River Plain.** Mazierski, P.F.; King, J.S. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

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The emplacement history and petrochemical evolution of the volcanics associated with Pine Butte, Crater Butte, and other nearby vents are developed and described. Four major vents were identified in the study area and their associated eruptive products were mapped. All of the vents show a marked physical elongation or linear orientation coincident with the observed rift set. Planetary exploration has revealed the importance of volcanic processes in the genesis and modification of extraterrestrial surfaces. Interpretation of surface features has identified plains-type basaltic volcanism in various mare regions of the Moon and the volcanic provinces of Mars. Identification of these areas with features that appear analogous to those observed in the Pine Butte area suggests similar styles of eruption and mode of emplacement. Such terrestrial analogies serve as a method to interpret the evolution of volcanic planetary surfaces on the inner planets.

44337 (N—87-23341, pp 3) **Geology of Picacho Butte, a silicic volcanic dome in northwest Arizona.** Kisiel, A.P.; King, J.S. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

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The purpose of this investigation was to determine the geologic history of Picacho Butte and vicinity through careful mapping of a 38 square kilometer area surrounding the peak. A detailed analysis of the geochemistry and petrology will aid in the development of a petrogenetic model for the area. The relationship of Picacho Butte to regional volcanism in Arizona, and more specifically to nearby volcanic centers can thus be established. Furthermore, in conjunction with this study a search will be made for possible planetary analogs exhibiting photogeologic characteristics similar to those in northern Arizona.

44338 (N—87-23341, pp 3) **Experimental studies of collision and fragmentation phenomena.** Hartmann, W.K.; Davis, D.R.; Weidenschilling, S.J. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

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The reduction and publication of an extensive data set collected in experiments over several years at Ames and PSI is briefly examined. Hartmann has been assembling data sets from his experiments on catastrophic fragmentation of various materials, including basalt, other igneous rock, ice, and weak dirt clods. Weidenschilling and Davis have continued to gather and reduce data on oblique impacts. The data indicate a power law distribution of ejecta mass vs. velocity, with a slope that is independent of azimuth, and does not vary with impact angle from normal impacts to at least 75 deg from vertical. In order to improve models of coagulation of dust aggregates in the solar nebula, SJW developed an apparatus for drop tests of fragile projectiles. Davis and Weidenschilling continued to collect and analyze experimental data on collisional catastrophic disruption at the Ames Vertical Gun Range.

44339 (N—87-23341, pp 3) **Impact and cratering processes on asteroids, satellites, and planets.** Chapman, C.R.; Davis, D.R.; Weidenschilling, S.J. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

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A new model for scaling the outcome of catastrophic collisions from laboratory scale experiments was developed and applied to large bodies where gravitational binding is dominant. This algorithm includes a pressure dependent impact strength which predicts that large asteroids behave as intrinsically strong objects due to compressive loading of overburden throughout their interiors. For small bodies, where the gravitational loading is negligible, this model assumes that the impact strength is independent of size. There was considerable discussion of scaling laws for disruption when these results were presented to one authors colleagues. The pressure strengthening impact strength model was viewed as physically quite plausible; however, it was argued that the impact strength should decrease with increasing size in the size range where gravitational compression is negligible.

44340 (N—87-23341, pp 3) **Crater production on Venus and Earth by asteroid and comet impact.** Shoemaker, E.M.; Wolfe, R.F. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

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New calculations of the collision probabilities of asteroids and comets with Venus were carried out based on the orbits of the known Venus-crossing asteroids and comets. For comparison, asteroid and comet collision probabilities and cratering rates on the Earth and Moon were recalculated and the estimated cratering rates on Venus were normalized to those of the Earth.

44341 (N—87-23341, pp 3) **Surface age of Venus: applying the terrestrial cratering rate.** Schaber, G.G.; Shoemaker, E.M.; Kozak, R.C. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

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The population of Venusian craters having suspected impact crater morphology has been reported from 115 x 10 to the 6th power sq km of the northern hemisphere of the planet with the estimated average age of the surface to be approx. 1 b.y. (+ or - 0.5 b.y.) on the basis of lunar crater production curves corrected for Venus. Such an old average age is somewhat difficult to reconcile with the similarity in size and mass of Venus and Earth and with Earth's high heat flow and crustal resurfacing rate. Given the present uncertainties in the role of both active and inactive comet nuclei in the cratering history of Earth, it is concluded that the average age of the observed surface in the northern hemisphere of Venus could be as great as the 450 m.y. mean age of the Earth's crust. The surface of Venus might be even older, but no evidence from the crater observations support an age as great as 1 b.y.

44342 (N—87-23341, pp 3) **Statistical study of Mercurian crater classes applied to the emplacement of the intercrater plains.** Woronow, A.; Love, K. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

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Two principal processes have been invoked for emplacement of the intercrater plains: (1) basin ejecta and autochthonous surface materials reworked by that ejecta or (2) volcanic flows. A new approach was taken: the multivariate statistical analysis of crater class. The results of the analysis constrain the formative process of the intercrater plains units to have affected craters on both terrains in a similar manner. Any emplacement process brief in temporal extent (compared to the period of late heavy bombardment), such as emplacement of ejecta from a single event or a brief period of extensive volcanism, violates this constraint. This analysis is briefly discussed.

44343 (N—87-23341, pp 3) **Revision of the Martian relative age chronology.** Barlow, N.G. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

This study has provided a more detailed chronology than currently exists in the literature and has created some changes to the currently accepted geological evolutionary sequence of Mars. The period of heavy bombardment, although dominated by impact processes, experienced many forms of volcanic activity and at least one episode of intense fracturing. Most small volcanic constructs and the ridged plains regions are found to date from this early period, contrary to common belief. The fracturing and dissection of the highlands helps to provide further constraints on the timing of events such as the formation of the hemispheric dichotomy and the formation of the Tharsis Bulge. The northern plains are found to consist of a number of differently aged regions. The difference in age between the chaotic terrain and the outflow channels together with differences in the distribution curves among craters of various erosional states found on the channels support the theory of episodic periods of flooding.

44344 (N—87-23341, pp 2) **Early changes in gradation styles and rates on Mars.** Schultz, P.H.; Britt, D. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

The wide annulus of massifs and knobs of Isidis and Argyre provided sufficiently large areas for meaningful crater statistics of large craters. Counts were made over adjacent and nested areas in order to test consistency and to derive relative age of each basin. Within the Isidis annulus, charateristic terrains provided counting areas for dating contrasting surface process: channeled hummocky terrain, etched terrains, and intermassif channeled plains. The channeled hummocky terrain contains a high channel density of narrow valley networks cutting both primary Isidis features and old craters. The etched terrains represent a broad region outside the inner high relief massifs of southwestern Isidis where numerous irregular plateaus, mesas, and relict craters indicate a different style of erosion. The intermassif channeled plains occur along the inner mountainous ring. Shallow meandering channels form a large integrated drainage system that is linked to numerous smaller intermountainous basins. These ponds and interconnected tributaries extend beyond the primary inner massif ring through broad canyons.

44345 (N—87-23341, pp 3) **Thermal inertia characteristics of the Martian crater Curie.** Horner, V.M.; Zimbelman, J.R. (Lunar and Planetary Institute, Houston, TX). May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

Thermal inertia characteristics have been determined for the martian crater Curie from high resolution groundtracks of Viking Thermal Infrared Mapper (IRTM) data. Flow features near the southeastern edge of the ejecta indicate that at least part of the Curie ejecta was emplaced in a manner similar to the ejecta of ram-

part craters. Within the study region there appears to be a general southeastern trend towards lower thermal inertia values. This trend may be related to the proximity of the Arabia region, which is mainly to the south and east of Curie. Curie is in a region where the overall thermal inertias change over relatively short distances radial to Arabia. Therefore, the observed general decrease in thermal inertia may represent increasing regional dust accumulation in the direction of Arabia.

44346 (N—87-23341, pp 3) **Dome craters on Ganymede.** Moore, J.M.; Malin, M.C. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

Voyager observations reveal impact craters on Ganymede that are characterized by the presence of broad, high albedo, topographic domes situated within a central pit. Fifty-seven craters with central domes were identified in images covering approx. 50% of the surface. Owing to limitations in resolution, and viewing and illumination angles, the features identified are most likely a subset of dome craters. The sample appears to be sufficiently large to infer statistically meaningful trends. Dome craters appear to fall into two distinct populations on plots of the ratio of dome diameter to crater rim diameter, large-dome craters and small-dome craters. The two classes are morphologically distinct from one another. In general, large dome craters show little relief and their constituent landforms appear subdued with respect to fresh craters. The physical attributes of small-dome craters are more sharply defined, a characteristic they share with young impact craters of comparable size observed elsewhere in the solar system. Both types of dome craters exhibit central pits in which the dome is located. As it is difficult to produce domes by impact and/or erosional processes, an endogenic origin for the domes is reasonably inferred. Several hypotheses for their origin are proposed. These hypotheses are briefly reviewed.

44347 (N—87-23341, pp 3) **Comments on the tectonism of Venus.** Kozak, R.C.; Schaber, G.G. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

Preliminary tectonic mapping of Venus from Venera 15/16 images shows unquestionable evidence of at least limited horizontal tectonism. The majority of tectonic features on Venus have no relation to topography. In fact, many axes of disruption interconnect, and cross sharp topographic boundaries at large angles, thereby discounting gravity as the driving force. Compressional zones (CZ's), unlike Extensional zones (EZ's), tend to be discontinuous, and, whereas EZ's cross tectonic and topographic boundaries at various angles, many CZ's on Venus are subparallel to these boundaries. Strike-like faulting is curiously lacking from the mapping, possible due to the steep incidence angle of the radar, which is far from optimal for detecting faults of small throw. A chronology of horizontal crustal movements, and hence the analysis of Venus' thermal development, is large dependent on understanding the crater form features. Regardless of their uncertain origin, the craters still could hold the answer to whether, and to what extent, crustal shuffling is occurring on Venus.

44348 (N—87-23341, pp 3) **Lithospheric structure on Venus from tectonic modelling of compressional features.** Banerdt, W.B.; Golombek, M.P. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

In previous studies, extensional models were used that incorporated realistic rheologies in order to constrain lithospheric structure. Lithospheric modelling is considered herein from the standpoint of compressional deformation. Features of presumed compressional tectonic origin are reviewed and a model for compressional folding based on lithospheric strength envelopes are presented that include the effects of both brittle and ductile yielding as well as finite elastic strength. Model predictions are then compared with the widths and spacings of observed tectonic features and it is concluded that the results are consistent with a thin crust overlying a relatively stronger mantle, with thermal gradients probably in the range of 10 to 15 deg/km.

44349 (N—87-23341, pp 3) **Venusian tectonics: convective coupling to the lithosphere?.** Phillips, R.J. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

The relationship between the dominant global heat loss mechanism and planetary size has motivated the search for tectonic style on Venus. Prior to the American and Soviet mapping missions of the past eight years, it was thought that terrestrial style plate tectonics was operative on Venus because this planet is approximately the size of the Earth and is conjectured to have about the same heat source content per unit mass. However, surface topography mapped by the altimeter of the Pioneer Venus spacecraft did not show any physiographic expression of terrestrial style spreading ridges, trenches, volcanic arcs or transform faults, although the horizontal resolution was questionable for detection of at least some of these features. The Venera 15 and 16 radar missions mapped the northern latitudes of Venus at 1 to 2 km resolution and showed that there are significant geographic areas of deformation seemingly created by large horizontal stresses. These same high resolution images show no evidence for plate tectonic features. Thus a fundamental problem for venusian tectonics is the origin of large horizontal stresses near the surface in the apparent absence of plate tectonics.

44350 (N—87-23341, pp 3) **Bilateral symmetry across Aphrodite Terra.** Crumpler, L.S.; Head, J.W.; Campbell, D.B. (Arecibo Ionospheric Observatory, Puerto Rico). May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

There are three main highland areas on Venus: Beta Regio, Ishtar Terra and Aphrodite Terra. The latter is least known and the least mapped, yet existing analyses of Aphrodite Terra based on available Pioneer-Venus orbiter data suggest that it may be the site of extensive rifting. Some of the highest resolution (30 km) PV data (SAR) included most of the western half of Aphrodite Terra. Recent analysis of the SAR data together with Arecibo range-doppler topographic profiling (10 X 100 km horizontal and 10 m vertical resolution) across parts of Aphrodite, further characterized the nature of possible tectonic processes in the equatorial highlands. The existence of distinct topographic and radar morphologic linear discontinuities across the nearly east-west strike of Aphrodite Terra is indicated. Another prominent set of linear features is distinctly parallel to and orthogonal to the ground tracks of the PV spacecraft and are not included because of the possibility that they are artifacts. Study of the northwest trending cross-strike discontinuities (CSD's) and the nature of topographic and morphologic features along their strike suggest the presence of bilateral topographic and morphologic symmetry about the long axis of Aphrodite Terra.

44351 (N—87-23341, pp 3) **Secular cooling of Earth as a source of intraplate stress.** Solomon, S.C. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

The once popular idea that changes in planetary volume play an important role in terrestrial orogeny and tectonics was generally discarded with the acceptance of plate tectonics. It is nonetheless likely that the Earth has been steadily cooling over the past 3-4 billion years, and the global contraction that accompanied such cooling would have led to a secular decrease in the radius of curvature of the plates. The implications of this global cooling and contraction are explored here for the intraplate stress field and the evolution of continental plates.

44352 (N—87-23341, pp 3) **Test of the hypothesis that impact-induced fractures are preferred sites for later tectonic activity.** Solomon, S.C.; Duxbury, E.D. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

Impact cratering has been an important process in the solar system. The cratering event is generally accompanied by faulting in adjacent terrain. Impact-induced faults are nearly ubiquitous over

large areas on the terrestrial planets. The suggestion is made that these fault systems, particularly those associated with the largest impact features are preferred sites for later deformation in response to lithospheric stresses generated by other processes. The evidence is a perceived clustering of orientations of tectonic features either radial or concentric to the crater or basin in question. An opportunity exists to test this suggestion more directly on Earth. The terrestrial continents contain more than 100 known or probable impact craters, with associated geological structures mapped to varying levels of detail. Prime facie evidence for reactivation of crater-induced faults would be the occurrence of earthquakes on these faults in response to the intraplate stress field. Either an alignment of epicenters with mapped fault traces or fault plane solutions indicating slip on a plane approximately coincident with that inferred for a crater-induced fault would be sufficient to demonstrate such an association.

44353 (N—87-23341, pp 3) **Physiographic constraints on the origin of lunar wrinkle ridges.** Golombek, M.P.; Franklin, B.J. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

Wrinkle ridges are linear asymmetric topographic highs with considerable morphologic complexity that are commonly found on the lunar maria and the smooth plains of Mars and Mercury. The origin of planetary wrinkle ridges has been a much argued and debated topic. Early ideas suggested that wrinkle ridges resulted from volcanic intrusion and extrusion of high viscosity lavas; these early ideas were countered with suggestions that wrinkle ridges formed from tectonic processes involving folding and faulting. Combined volcanic and tectonic mechanisms have also been suggested. The identification and analysis of a number of morphologically similar structures on the earth has helped in the recent interpretation of wrinkle ridges as thrust faults that deform surface rocks. Nevertheless, there remains the uncertainty of the dominant role of thrusting versus folding in the formation of planetary wrinkle ridges. Presented is a detailed physiographic analysis of lunar wrinkle ridges in an effort to help distinguish the dominant deformation mechanism. Results agree with the findings of the earth analog study and support the hypothesis that wrinkle ridges form from thrust faults that deform surface rocks.

44354 (N—87-23341, pp 3) **Lithospheric loading and tectonics of the lunar irregular maria.** Hall, J.L.; Solomon, S.C. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

Many of the tectonic features associated with the circular maria are the result of stresses generated by loading of the lunar lithosphere by mare basalt units. The hypothesis is tested that the irregular lunar maria share with the circular maria the processes leading to the formation of associated graben and mare ridge systems. A formulation of the lithospheric flexure problem that accounts for the variable distribution of basalt loads for the irregular maria is applied. On the basis of the tectonic structures and geologic history of each of the major irregular maria, as well as models for the distribution of mare basalt for each region, the predicted stress fields are compared with the distribution of tectonic features for a range of assumed values of the thickness of the elastic lithosphere. The best fitting values for lithospheric thickness beneath the regular maria are then compared with those previously inferred for the circular maria.

44355 (N—87-23341, pp 3) **Martian crustal dichotomy: product of accretion and not a specific event?.** Frey, H.; Schultz, R.A.; Maxwell, T.A. (National Air and Space Museum, Washington, DC). May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

Attempts to explain the fundamental crustal dichotomy on Mars range from purely endogenic to extreme exogenic processes, but to date no satisfactory theory has evolved. What is accepted is: (1) the dichotomy is an ancient feature of the Martian crust, and (2) the boundary between the cratered highlands and northern plains which marks the dichotomy in parts of Mars has undergone significant and variable modification during the observable parts of Martian history. Some ascribe it to a single mega-impact event, essentially an instantaneous rearrangement of the crustal structures (topography and lithospheric thickness). Others prefer an internal mechanism: a period of vigorous convection subcrustally erodes the northern one third of Mars, causing foundering and isostatic lowering of that part of Mars. The evidence for each theory is reviewed, with the conclusion that there is little to recommend either. An alternative is suggested: the formation of the crustal dichotomy on Mars was not a specific tectonic event but a byproduct of the accretionary process and therefore a primordial characteristic of the Martian crust, predating the oldest recognizable landforms.

44356 (N—87-23341, pp 2) **Implications of Viking color data for evolution of the Amenthes Region, Mars.** Maxwell, T.A. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

In the Eastern Hemisphere of Mars, where the hemispheric dichotomy is not overlain by relatively recent flows from the Tharsis volcanoes, the Mars cratered terrain boundary (CTB) now exists as highly fractured terrain juxtaposed with the smooth plains of the Northern Hemisphere. Based on Mariner 9 photography, the southern cratered terrain in the Amenthes region (0 to 30 deg N, 225 to 270 deg W) is approximately 3 to 4 km above the northern plains, and the transition zone is marked by both broad plateaus and knobby terrain. In the Amenthes Southest quadrangle, in particular, the continuum between large detached plateaus, smaller smooth topped plateaus and knobby hills can be seen. To define the previous position and evolution of the boundary, the distribution of cratered terrain, characteristic landforms (knobby terrain and detached plateaus) have been mapped, as well as structural features across the boundary. Structural mapping indicates that geological formations parallel the boundary in the Eastern Hemisphere with the conclusion that CTB evolution involved normal faulting through extension perpendicular to the boundary.

44357 (N—87-23341, pp 2) **Timing of ancient extensional tectonic features on Mars.** Wichman, R.; Schultz, P.H. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

Although numerous studies have delineated the Tharsis and post-Tharsis volcanic/tectonic history on Mars, only a few attempts have examined the earlier epochs. This is not an easy task since unambiguous crater ages for pre-Tharsis and early Tharsis units are difficult to determine owing to a variety of active surface processes. Ancient tectonic features, however, have a sufficiently large superposed crater population that should permit relative dating. A technique for crater counting along linear features analagous to areal crater density is proposed. A modification of this approach has been tested and applied to a variety of ancient tectonic features.

44358 (N—87-23341, pp 2) **Stress history of the Tharsis Region, Mars.** Francis, R.A. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

The Tharsis topographic rise of Mars is roughly 5000 km wide and 10 km high and is believed to have originated more than 3.5 BY ago. Within its boundaries lie the four largest volcanoes on the planet. It is also the locus of a series of fracture traces which extend over approximately a hemisphere. The events leading to the formation of the Tharsis region continue to generate debate. Three geophysical models of the formation of Tharsis are now in general contention and each of these models has been used to predict a characteristic stress-field. These models are: the volcanic construct model, the isostatic compensation model, and the lithospheric uplift model. Each has been used by its proponents to predict some of the features observed in the Tharsis region but none accurately accounts for all of the fracture features observed. This is due, in part, to the use of fractures too young to be directly related to the origin of Tharsis. To constrain the origin of Tharsis, as opposed to its

later history, one should look for the oldest fractures related to Tharsis and compare these to the predictions made by the models. Mapping of old terrains in and around the Tharsis rise has revealed 175 hitherto unknown old fracture features.

44359 (N—87-23341, pp 3) **History and morphology of faulting in the Noctis Labyrinthus-Claritas Fossae Region of Mars.** Tanaka, K.L.; Davis, P.A. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of planetary geology and geophysics program, 1986.

The topographically high areas cut by Noctis Labyrinthus, Noctis Fossae, and Claritas Fossae were subjected to only minor resurfacing during and following local tectonic activity. Principal resurfacing materials consist of lava flows from Syria Planum and Tharsis Montes. Thus, these areas preserve much of the fault record produced by tectonism in this region. Although recent geologic maps of the area have been produced from Viking images, the only detailed fault histories available until now were described from Mariner 9 images. Much of the faulting in the Tharsis tectonic province was centered in Syria Planum; therefore, understanding the fault history in this region is critical to understanding the stress history and tectonism of Tharsis as a whole.

44360 (N—87-23341, pp 3) **Thin and thick-skinned deformation in the Tharsis Region of Mars.** Watters, T.R. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of Planetary Geology and Geophysics Program, 1986.

The ridge system of the Tharsis Plateau is a dominant structural form equaled only by the radial fracture system. The structural interpretation of the ridges are: (1) folds formed by regional or local compressional stress; (2) the surface manifestation of reverse or thrust faults; or (3) folds with thrust faulting developing as a result of fold geometry. It has been suggested that the compressional events that generated the ridges occurred after the emplacement of the ridged plains volcanic units, but before the episode of faulting that generated the majority of the observed ridge-fault crosscutting relationships on the ridged plains and that it did not continue beyond the emplacement of the Syria Planum Formation or the basal units of the Tharsis Montes Formation. Models for the origin of the regional stresses involving a combination of isostatic uplift and flexural loading were proposed.

44361 (N—87-23341, pp 3) **Flexurally-resisted uplift of the Tharsis Province, Mars.** Phillips, R.J.; Sleep, N.H. (Stanford Univ., CA). May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of Planetary Geology and Geophysics Program, 1986.

The tectonic style of Mars is dominated by vertical motion, perhaps more than any of the terrestrial planets. The imprint of this tectonic activity has left a surface widely faulted even though younger volcanism has masked the expression of tectonism in many places. Geological activity associated with the Tharsis and, to a lesser extent, Elysium provinces is responsible for a significant portion of this faulting, while the origins of the remaining features are enigmatic in many cases. The origin and evolution of the Tharsis and Elysium provinces, in terms of their great elevation, volcanic activity, and tectonic style, has sparked intense debate over the last fifteen years. Central to these discussions are the relative roles of structural uplift and volcanic construction in the creation of immense topographic relief. For example, it is argued that the presence of very old and cratered terrain high on the Tharsis rise, in the vicinity of Claritas Fossae, points to structural uplift of an ancient crust. Others have pointed out, however, that there is no reason that this terrain could not be of volcanic origin and thus part of the constructional mechanism.

44362 (N—87-23341, pp 2) **Tectonic domains in the Eastern hemisphere of Mars.** Maxwell, T.A.; Leff, C.E. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of Planetary Geology and Geophysics Program, 1986.

The definition of boundaries of discrete structural provinces on the surface of Mars has previously been made by the assumptions of circular or radial symmetry (in the case of the Tharsis olateau), by artificial quadrangle boundaries for regional studies, or simply by regional geographical features. Much of the planetary structural mapping has been presented in a line or spot format in existing consortium data. Methods are being generated to convert the detailed maps of tectonic features to a format that can be used with standard image processing techniques. In this manner such data can be more readily compared to age and other attributes deduced from geological mapping, gravity results, and topography. The 24 photomosaics covering the Eastern Hemisphere of Mars have already been examined for four types of structural features: erosional remnants, ridges, graben, and scarps. When digitized, each feature was flagged according to feature type, azimuth and length. These values were stored as text files on a quad-by-quad basis for each quad studied.

44363 (N—87-23341, pp 3) **Geometry and relative age of large patterned fractures in southern Acidalia Planitia, Mars.** Borrello, M.C. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of Planetary Geology and Geophysics Program, 1986.

Extraordinary patterned fractures occur in Elysium, Utopia, and Acidalia Planitiae of Mars. Theories as to their origin range from permafrost patterning to tectonic fracturing. Recent studies indicate the patterned fractures may be a surface reflection of rough, buried terrane in which fracturing occurs as a result of differential compaction. The patterned terrane in the southern portion of the Acidalia region (MC4-SE, MC4-SC) is being studied to determine its age relative to other terranes and events, and to constrain models for the origin of the fractures. Fracturing in this area occurs between 5 and 25 degrees west longitude and 37 and 50 degrees north latitude. Many fracture patterns are roughly polygonal, with polygons ranging in size from approximately 11 to 32 km in diameter. Fracture traces range from the limit of resolution (10's of meters) to 35 km in length.

44364 (N—87-23341, pp 3) **Creep of ice: further studies.** Heard, H.C.; Durham, W.B.; Kirby, S.H. (Geological Survey, Menlo Park, CA). May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of Planetary Geology and Geophysics Program, 1986.

Detailed studies have been done of ice creep as related to the icy satellites, Ganymede and Callisto. Included were: (1) the flow of high-pressure water ices II, III, and V, and (2) frictional sliding of ice I sub h. Work was also begun on the study of the effects of impurities on the flow of ice. Test results are summarized.

44365 (N—87-23341, pp 3) **Geology of Io.** Greeley, R.; Craddock, R.A.; Crown, D.A.; Leshin, L.A.; Schaber, G.G. (Geological Survey, Flagstaff, AZ). May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of Planetary Geology and Geophysics Program, 1986.

Geologic mapping of the Jovian satellite Io has been completed at 1:15,000,000 scale for an area lying between +40 and -90 deg latitude and 230 and 45 deg longitude, which includes portions of the Ruwa Patera quadrangle (Ji2) and the Lerna Region (Ji4) and the westernmost section of the Colchis Region (Ji3). Image resolution in the mapped area is commonly 0.5 to 2 km/pxl. High resolution areas (less than .5 km/pxl) are located near the south pole (Lerna Region) and in eastern Ruwa Patera quadrangle. Geologic maps for the Ruwa Patera quadrangle (Ji2) and the Lerna Region (Ji4) have been produced at 1:5,000,000 scale. The present effort reexamines the previously mapped areas and synthesizes the geology of Io on a global scale.

44366 (N—87-23341, pp 2) **Unified lunar control network.** Davies, M.E.; Colvin, T.R.; Meyer, D.L. (Defense Mapping Agency Aerospace Center, St. Louis, MO). May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of Planetary Geology and Geophysics Program, 1986.

Mapping network control on the Moon is composed of a number of independent regional networks. These networks frequently have different origins but never have common ties, even in overlapping areas. The objective of the unified network program is to tie the regional networks into a single consistent planetwide control network. The plan is to start with the best defined regions, create common ties with neighboring data sets, and then expand into poorly defined regions. The most accurately defined points on the Moon are locations of the laser ranging retroreflectors and the VLBI measurements of the locations of the Apollo 15, 16, 17 ALSEP stations. Recent values for the coordinates of the retroreflectors have been received. The accuracy of these locations is about 30 m and their locations are used to define the center-of-mass and, hence, the origin of the unified lunar coordinate system. The coordinates of the retroreflectors are given in both principal axis and mean Earth/Polar axis systems. Mean Earth/Polar axis coordinates have been recommended by the IAU for the Moon. The difference in the coordinates is important, more than 600 m in latitude and longitude.

44367 (N—87-23341, pp 3) **Martian terrains.** Masursky, H.; Chapman, M.G.; Davis, P.A.; Dial, A.L. Jr.; Strobell, M.E. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

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Terrain studies of candidate landing sites for a future rover/sample-return mission to Mars are being conducted to evaluate the geologic and trafficability aspects of each site. An optimum site should have geologic units of widely diverse ages and chemical compositions occurring in close enough proximity and in smooth enough terrain so that a roving vehicle of limited traverse ability (+ or - 100 km) could collect representative samples. In FY 1986, geologic maps were compiled at 1:500,000 and 1:2 million scales of the Mangala Valles, Kasei Valles, Chasma Boreale (north polar), and Planum Australe (south polar) areas, and a study was begun of the topography and surface roughness characteristics of the Mangala Valles site. Geologic mapping has been greatly facilitated by specially enhanced, high-resolution Viking photographs, which clarify stratigraphic relations of units unrecognized earlier. Photoclinometric profiles of topographic features provide width and depth measurements of four classes of channels, the thickness of some volcanic units, and the throw on some faults. Estimates of the surface roughness of units are calculated using a newly developed USGS computer program and using measurements derived from Earth-based radar.

44368 (N—87-23341, pp 1) **Enhanced LANDSAT images of Antarctica and planetary exploration.** Lucchitta, B.K.; Bowell, J.A.; Edwards, K.; Eliason, E.M.; Ferguson, H.M. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of Planetary Geology and Geophysics Program, 1986.

Since early in the LANDSAT program, black-and-white paper prints of band 7 (near infrared) of the LANDSAT multispectral scanner have been used extensively to prepare semicontrolled maps of Antarctica. Image-processing techniques are now employed to enhance fine detail and to make controlled image-mosaic maps in color. LANDSAT multispectral images of Antarctica help to expand our knowledge of extraterrestrial bodies by showing bare-ice areas as bright blue patches; on such patches meteorites tend to be concentrated and are collected. Many subtle flow features in Antarctic ice streams resemble features at the mouths of Martian outflow channels, which suggests that the channels also contained ice. Furthermore, flow lines in Antarctic ice sheets that merge with ice shelves resemble Martian flow features associated with dissected terrain along the Martian northern highland margin, and support the concept that ice was involved in the transport of material from the southern highlands to the northern lowland plains. In Antarctica, as on Mars, the virtual absence of fluvial activity over millions of years has permitted the growth of glacial and eolian features to unusually large sizes.

44369 (N—87-23341, pp 1) **Compositional stratigraphy of crustal material from near-infrared spectra.** Pieters, C.M. May 1987. NTIS, PC A24/MF A01. (NASA-TM—89810; NAS—1.15:89810).

In Reports of Planetary Geology and Geophysics Program, 1986.

An Earth-based telescopic program to acquire near-infrared spectra of freshly exposed lunar material now contains data for 17 large impact craters with central peaks. Noritic, gabbroic, anorthositic and troctolitic rock types can be distinguished for areas within these large craters from characteristic absorptions in individual spectra of their walls and central peaks. Norites dominate the upper lunar crust while the deeper crustal zones also contain significant amounts of gabbros and anorthosites. Data for material associated with large craters indicate that not only is the lunar crust highly heterogeneous across the nearside, but that the compositional stratigraphy of the lunar crust is nonuniform. Crustal complexity should be expected for other planetary bodies, which should be studied using high spatial and spectral resolution data in and around large impact craters.

44370 (N—87-23561) **J. VLA (Very Large Array) of a solar noise storm.** Lang, K.R.; Willson, R.F. (Tufts Univ., Medford, MA (USA)). 1986. 20p. (NASA-CR—180219; NAS—1.26:180219; AD-A—179664). NTIS, PC A02/MF A01.

The first Very Large Array (VLA) observations of the Sun at 92 cm wavelength (328 MHz) are presented. A 3-hr solar noise storm was detected; it consisted of burst-like spikes superimposed on a slowly varying background, and both storm components were 95 + or - 5% right-hand circularly polarized. A long duration soft x-ray event preceded the radio radiation by 30 m, suggesting a disturbance moving outwards at a velocity of v = 78 km/s. The 92 cm noise storm was resolved with an angular resolution of 9 sec for time intervals as short as 13 s. During the onset and early phases, the storm consisted of four compact sources, each with an angular diameter of 40 sec, oriented within an elongated source with angular dimensions of 40 sec by 200 sec. During the subsequent hour the most intense emission was located in two 40 sec sources separated by 100 sec. Snapshot maps revealed a persistent elongated source at successive peaks, with a scatter in the source position. A systematic position shift of Deta Theta sub I greater than or = 15 sec can be produced by the Earth's ionosphere, but these effects can be removed by frequent observations of a nearby calibrator source. The observations confirm previously reported trends for a decrease in source size at higher frequencies, but they suggest a hitherto unresolved complexity in source structure.

44371 (PB—87-195251/XAB) **Solar-Geophysical Data Number 512, April 1987. Part 1 (prompt reports). Data for March 1987, February 1987, and late data.** Coffey, H.E. (National Geophysical Data Center, Boulder, CO (USA)). Apr 1987. 84p. (SGD—512-PT-1). NTIS, PC A05/MF A01.

See also Part 2, PB—87-195269, and PB—87-181194.

Contents include: Detailed index for 1986-1987; Data for March 1987--(IUWDS alert periods (Advance and Worldwide), Solar activity indices, Solar flares, Solar radio emission, Vostok inferred interplanetary magnetic field polarity, Stanford mean solar magnetic field); Data for February 1987 - (Solar-active regions, Sudden ionospheric disturbances, Solar radio-spectral observations, Cosmic-ray measurements by neutron monitor, Geomagnetic indices, Radio-propagation indices); Late data--(Cosmic-ray measurements by neutron monitor, Tokyo October 1986-January 1987; Geomagnetic indices January 1987; Solar-active regions, Geomagnetic indices, January 1987).

44372 (PB—87-195269/XAB) **Solar-Geophysical Data Number 512, April 1987. Part 2 (comprehensive reports). Data for October 1986.** Coffey, H.E. (National Geophysical Data Center, Boulder, CO (USA)). Apr 1987. 50p. NTIS, PC A03/MF A01.

Contents include: Detailed index for 1986-1987; Data for October 1986 (Meudon carte synoptique, Solar flares, Solar radio bursts at fixed frequencies, Solar x-ray radiation from GOES satellite, Mass ejections from the sun, Active prominences and filaments.

44373 **(PB—87-196382/XAB) White light solar corona: an atlas of 1986 K-coronameter synoptic charts, December 1985-January 1987. Technical note.** Sime, D.G.; Garcia, C.; Yasukawa, E.; Lundin, E.; Rock, K. (National Center for Atmospheric Research, Boulder, CO (USA)). Mar 1987. 84p. (NCAR/TN—280-STR). NTIS, PC A05/MF A01.

See also PB—87-138095.

The synoptic observing project of the High Altitude Observatory's Coronal Dynamics Program began on 5 August 1980. The data obtained for it are gathered by the Mark-III K-coronameter located at the Mauna Loa Solar Observatory, Hawaii, and are published yearly in volumes of The White Solar Corona: An Atlas Of K-Coronameter Synoptic Charts. The data are extended at both the beginning and the end of each volume to provide some overlap with the preceding and succeeding volumes. This is necessary to provide a complete set of the data organized into Carrington rotations covering a specific time period, since the rotations do not coincide with the yearly calendar. Further, observations are made at the limb, and west limb passage occurs 14 days after east limb passage. Thus, an entire rotation's data require more than 28 days to collect. As well as the synoptic maps, there are two additional sections designed to aid the user are included in this volume. As in previous Atlases, the Activity Report Summary for the year and Polar Synoptic Charts are included. Further, in this volume, the authors also include the Manuna Loa Solar Observatory Calendar for 1986. This is a list of days on which no coronal observations were achieved.

44374 **(PB—87-200580/XAB) Fe XIV solar corona at 5303 angstroms: an atlas of synoptic charts from the Sacramento Peak Coronal Photometer, May 1973-December 1985. Technical note.** Altrock, R.C.; Gilliam, L.B.; Sime, D.G.; Fisher, R.R. (High Altitude Observatory, Boulder, CO (USA)). Feb 1987. 188p. (NCAR/TN—276-STR). NTIS, PC A09/MF A01.

The report is an atlas of synoptic charts, from the Sacramento Peak Coronal Photometer, of the Fe XIV solar corona at 5303 A. Data cover May 1973 to December 1985.

44375 **(UCRL—15927) Accretion of matter onto highly magnetized neutron stars: Final report, July 1-September 30, 1985.** Hernquist, L. (California Univ., Berkeley (USA); Lawrence Livermore National Lab., CA (USA)). Jun 1986. Contract W-7405-ENG-48. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013495.

A final report is given of two research projects dealing with magnetic fields of neutron stars. These are the modulation of thermal x-rays from cooling neutron stars and plasma instabilities in neutron star accretion columns. (DWL)

44376 **(UCRL—95967) The impact of calculated photon-induced isomer production in ^{176}Lu on its use as a stellar chronometer and/or thermometer.** Gardner, M.A.; Gardner, D.G.; Hoff, R.W. (Lawrence Livermore National Lab., CA (USA)). 13 Jul 1987. Contract W-7405-ENG-48. 10p. (CONF-8708101—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013488.

From 6. international symposium on capture gamma-ray spectroscopy; Leuven, Belgium (31 Aug 1987).

We have calculated the production and destruction of the 3.7-h, 123-keV isomeric state of ^{176}Lu, by photons as well as by neutrons. We used absolute photon strength functions and well-tested, modeled, discrete nuclear level sets for $^{175-177}$Lu. Our results for the photon-induced production of /sup 176m/Lu are remarkably different from the experimental measurements in the current literature. We calculate much larger cross sections for this reaction, and a lower threshold than had previously been assumed. These two effects combine to indicate an enormous correction, a factor of 10^7, needs be applied to shorten the current estimate of the half-life against photoexcitation of /sup 176m/Lu as a function of temperature. 22 refs., 7 figs.

44377 **(UCRL—96523) Electrical conductivity and equation of state measurements on planetary fluids at high pressures and temperatures.** Hamilton, D.C.; Nellis, W.J.; Holmes, N.C.; Radousky, H.B.; Ree, F.H.; Nicol, M. (Lawrence Livermore National Lab., CA (USA); California Univ., Los Angeles (USA)). Jul 1987. Contract W-7405-ENG-48. 5p. (CONF-870753—65). NTIS, PC A02. File Number DE87013787.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

Hugoniot equation-of-state, shock temperature, and electrical conductivity measurements are reported for fluids believed to be the primary constituents of the planets Uranus and Neptune. The equation-of-state results are compared with calculations performed using a statistical mechanical, chemical equilibrium computer code and electrical conductivities are discussed in terms of the recently measured magnetic field of Uranus. 4 refs., 2 figs., 1 tab.

44378 **Discovery of 15-30 hertz quasi-periodic oscillations in the X-ray flux of 4U 1820-30.** Stella, L.; White, N.E.; Priedhorsky, W. (EXOSAT Observatory, Noordwijk, Netherlands; Los Alamos National Lab., NM; Max-Planck-Institut fuer extraterrestrische Physik, Garching, W). *Astrophysical Journal;* **315**: L49-L53(Apr 1987).

The 1984 Exosat observations of the fast-timing properties of 4U 1820-30 which led to the discovery of 15-30 Hz quasi-periodic oscillations (QPOs) in the X-ray flux of 4U 1820-30 are discussed. The QPOs observed were found to vary in frequency between 15 and 30 Hz and in strength between 5 and 8 percent rms, without any clear correlation with the source intensity or spectral hardness. Substantial red noise was observed, detectable up to about 40 Hz, which did not correlate with the QPO strength. The observed behavioral features of the QPOs in the 4U 1820-30 X-ray flux are discussed in the frameworks of several QPO models. 34 references.

44379 **Anharmonicity and the interstellar polycyclic aromatic hydrocarbon infrared emission spectrum.** Barker, J.R.; Allamandola, L.J.; Tielens, A.G.G.M. (Michigan Univ., Ann Arbor; NASA, Ames Research Center, Moffett Field, CA; California Univ., Berkeley). *Astrophysical Journal;* **315**: L61-L65(Apr 1987).

The hypothesis that interstellar infrared emission originates from vibrationally excited polycyclic aromatic hydrocarbons (PAHs) requires that emission can arise from all vibrational levels that are energetically accessible. Due to anharmonicity, the emission from the upper vibrational levels is shifted to longer wavelengths from that of the $v = 1$-0 transition. It is shown that structure in the 3-micron region is readily and quantitatively explained by emission from upper vibrational levels of excited PAHs that contain a maximum of 20-30 carbon atoms. The asymmetrical broadening of the 11.3-micron emission band may also be due to anharmonicity. 21 references.

44380 **Hot spots in the microwave sky.** Vittorio, N.; Juszkiewicz, R. (Roma Universita, Italy; California Univ., Berkeley; Observatorium Astronomiczne, Centrum Astronomiczne, Warsaw, Poland). *Astrophysical Journal;* **314**: L29-L32(Mar 1987).

L29-L32. DOE-supported research.

Tha assumption that the cosmic background fluctuations can be approximated as a random Gaussian field implies specific predictions for the radiation temperature pattern. Using this assumption, the abundances and angular sizes are calculated for regions of various levels of brightness expected to appear in the sky. Different observational strategies are assessed in the context of these results. Calculations for both large-angle and small-angle anisotropy generated by scale-invariant fluctuations in a flat universe are presented. Also discussed are simple generalizations to open cosmological models. 21 references.

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REFER ALSO TO CITATION(S) 43924, 44235, 44371, 44639

44381 (AD-A—180704/9/XAB) Extreme- and far-ultraviolet emissions from the polar cap. Chakrabarti, S. (California Univ., Berkeley (USA). Space Sciences Lab.). 1 Jul 1986. 9p. NTIS, PC A02/MF A01.

Pub. in Jnl. of Geophysical Research, Vol. 91, No. A7, 8065-8072(1 Jul 1986).

Satellite observations of polar cap emissions in the 800 to 1400A band are reported. The data were obtained along the noon/midnight meridian on March 22, 1979, by the EUV spectrometer on board the STP78-1 satellite. The time-averaged spectrum shows no molecular band emissions. Several bright atomic-oxygen lines are present in the spectrum. Weak signals from atomic nitrogen are also seen. It is speculated that these emissions are caused by particles having similar characteristic energy to those producing emissions observed in the dayside cusp during the same pass.

44382 (AD-A—180705/6/XAB) Imaging the outflow of ionospheric ions into the magnetosphere. Chiu, Y.T.; Robinson, R.M.; Swenson, G.R.; Chakrabarti, S.; Evans, D.S. (Lockheed Missiles and Space Co., Palo Alto, CA (USA). Space Sciences Lab.). 31 Jul 1986. 4p. NTIS, PC A02/MF A01.

Pub. in Nature, Vol. 322, No. 6078, 441-444(31 Jul 1986).

The discovery of ionospheric ion outflow into the magnetosphere has been considered a major advance in magnetospheric physics in the past decade. Satellite measurements in situ are, however, too localized to address the global scope of the phenomenon. It is, therefore, important to consider methods to image the global outflow of ionospheric ions into the magnetosphere. The concept and verification of imaging the global ionospheric outflow is considered by using spectrophotometric observations of far-ultraviolet and extreme-ultraviolet solar lines resonantly scattered by ionospheric ions or exospheric neutrals in the auroral regions of the magnetosphere. New satellite observations are presented that verify the concept and show that this imaging capability is feasible with present technology.

44383 (AD-A—180875/7/XAB) Solar-wind dependencies of high-latitude convection and precipitation. Foster, J.C.; Holt, J.M.; Musgrove, R.G.; Evans, D.S. (Haystack Observatory, Westford, MA (USA)). 1986. 22p. NTIS, PC A02/MF A01.

Pub. in Solar Wind-Magnetosphere Coupling, 477-494(1986) Original contains color plates: All DTIC and NTIS reproductions will be in black and white.

The solar-wind plasma and interplanetary magnetic field (IMF) dependencies of the patterns of plasma convection and particle precipitation in the high-latitude ionosphere were investigated by constructing average patterns of the ionospheric electric field and the precipitating energy influx of different solar-wind conditions. A data base of over 100 days' observations of high-latitude plasma convection with the Millstone Hill radars was sorted and binned according to the one-hour averaged values of MF Bz and By. The individual line of sight velocities observed by the radar were combined in each magnetic latitude-local time bin to derive statistically averaged convection patterns between 50 and 73 degrees latitude. A 25-mV/m southward electric field is found at auroral latitudes in the midnight sector for IMF away sectors (By>O) while a southward-directed IMF increases the cross polar-cap potential difference from 15 kV (for Bz>+3 nT) to 75 kV (for Bz<-3 nT). For geomagnetically disturbed conditions (Kp=-to 5-), the additional requirement that Bz be negative results in a 30-kV potential difference across an enhanced dayside region of plasma entry into the polar cap.

44384 (AD-A—180990/4/XAB) Electron-density profiles from automatically scaled digital ionograms. the artist's valley solution. Technical report. Gamache, R.R.; Kersey, W.T.; Reinisch, B.W. (Lowell Univ., MA (USA). Center for Atmospheric Research). Jul 1985. 48p. (ULRF—4341CAR). NTIS, PC A03/MF A01.

Electron-density true-height profiles are calculated from automatically scaled Digisonde ionograms. The profile algorithm uses the modified polynomial fitting method separately for the E- and the F-region profile calculations. A new approach to considering the transition region between the E and F layers allows to determine the F profile with good accuracy from the ordinary echo trace. The total electron content between the peak of the E layer and the bottom of the F layer is estimated to account for the observed retardation as a function of frequency on the F trace. No effort is made to find the valley shape since this is not possible from the O trace alone. The new algorithm is tested on some model ionograms.

44385 (AD-A—181247/8/XAB) High-resolution measurement of OH infrared airglow structure. Technical report. Neal, P.C. (Utah State Univ., Logan (USA). Space Dynamics Lab.). 18 Oct 1985. 224p. (SDL—85-075). NTIS, PC A10/MF A01.

A bright OH Meinel airglow structure event was recorded on June 15, 1983 from Sacramento Peak, New Mexico. The MAPSTAR interferometer was operated in conjunction with low-light-level infrared imaging isocon camera system provided by the University of Southampton, England. The camera was co-aligned with the meter. The structures were measured at elevation angles near the horizon. Apparent wavelength, periods and phase velocities of 24 + or - 1 minutes, and 28 + or - 2 meters/second respectively, were calculated for the recorded structure. The interferometer data show intensity modulations of 20-40% within the structure. A mean rotational temperature of 165 °K was calculated using the interferometer spectral data and temperature modulations of 5 to 10 °K were recorded in phase with the intensity modulations. This report discusses the structure and performance of the MAPSTAR interferometer and telescope, as well as the results obtained using the sensor. Data collected shed new light on the phenomena under investigation and will provide a foundation for studies in the future.

44386 (ATR—6(8433)-4) Generation of electrostatic noise in the plasma sheet boundary layer. Dusenberry, P.B.; Lyons, L.R. (Colorado Univ., Boulder (USA). Cooperative Inst. for Research in Environmental Sciences). Sep 1986. 38p. NTIS, PC A03/MF A01.

The one and two ion beam instability is considered as a possible explanation for the observations of broad band electrostatic noise in the plasma sheet region of the geomagnetic tail. When only hot streaming plasma sheet boundary layer ions are present, no broad band waves are excited. Cold, streaming ionospheric ions can generate electrostatic broad band waves propagating in the slow beam acoustic mode, but the growth rates of the waves are significantly enhanced when hot boundary layer ions are present. (Both the slow and fast beam acoustic modes can be excited, depending on the relative ion drift.) This model predicts that the wave intensity of the broad band noise should peak in the plasma sheet boundary layer. Observations of less intense electrostatic waves in the lobes and plasma sheet are likely a result of the absence of hot ion beams or large ion temperatures, respectively, which result in smaller growth rates. The ion beam instability may play an important role in the formation of the central plasma sheet.

44387 (CONF-8710100—1) Development of a new high altitude electromagnetic pulse (HEMP) environment and resulting over head line responses. Tesche, F.M.; Barnes, P.R. (LuTech, Inc., Dallas, TX (USA); Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 59p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87011584.

From NATO/AGARD symposium on effects of electromagnetic noise and interference on the performance of military radio communications systems; Lisbon, Portugal (26 Oct 1987).

Being able to accurately determine the response of an electrical system which is excited by a high altitude nuclear electromagnetic pulse (EMP) requires a knowledge of the time history of the incident EMP field strength, as well as its angle of incidence and polarization. A commonly used, unclassified, description of this environment is provided by the "Bell Laboratory waveform." Recent studies have shown, however, that this EMP waveform tends to overestimate the response of an above-ground transmission line by more than an order of magnitude. As a result, other unclassified high altitude EMP environments have been developed. This

presentation discusses the development of two alternate unclassified EMP environment descriptions: one arising from a simple radiating dipole moment model, and the other resulting from curve-fitting the calculated fields from a computer code named CHAP. For both of these EMP models, the electric field at two earth observation points are compared. These fields are then coupled to an above-ground line and the resulting open-circuit voltage responses are compared. Using the CHAP EMP environment, a limited parametric study of the peak positive and negative open-circuit voltage is then performed and surface plots of these peak voltages are presented. 8 refs., 21 figs., 1 tab.

44388 **(EML—476) Quantification of the background signal to solar neutrino detection from cosmogenic activation of the atmosphere.** de la Zerda, A. (USDOE Environmental Measurements Lab., New York). Apr 1987. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013830.

Neutrinos are a by-product of the fusion reactions that are believed to generate the energy radiated by the sun. Attempts to measure the flux of neutrinos from the sun, yield a result that is in disagreement with theoretical expectations. In addition, a time variation of this flux over the 11-year solar cycle has been observed. In this work, we review the solar neutrino problem, examine the main features of the cosmic-ray field at the earth, and determine the neutrino flux from the decay of positron emitters resulting from the hadronic cascades induced in the atmosphere by galactic cosmic rays. Further, we study the variation of this background through the sunspot cycle. Our results indicate that this contribution to the neutrino flux is far too low to account for the observed correlation with solar activity. 14 refs., 5 figs., 4 tabs.

44389 **(N—87-22466) Boundary value problem for the solution of magnetic cutoff rigidities and some special applications.** Edmonds, L. (Jet Propulsion Lab., Pasadena, CA (USA)). Apr 1987. 77p. (NASA-CR—180916; JPL-PUB—87-9; NAS—1.26:180916). NTIS, PC A05/MF A01.

Since a planet's magnetic field can sometimes provide a spacecraft with some protection against cosmic ray and solar flare particles, it is important to be able to quantify this protection. This is done by calculating cutoff rigidities. An alternate to the conventional method (particle trajectory tracing) is introduced, which is to treat the problem as a boundary value problem. In this approach trajectory tracing is only needed to supply boundary conditions. In some special cases, trajectory tracing is not needed at all because the problem can be solved analytically. A differential equation governing cutoff rigidities is derived for static magnetic fields. The presense of solid objects, which can block a trajectory and other force fields are not included. A few qualititative comments, on existence and uniqueness of solutions, are made which may be useful when deciding how the boundary conditions should be set up. Also included are topics on axially symmetric fields.

44390 **(N—87-23066) Preliminary study of extended magnetic field structures in the ionosphere. Status report.** Sullivan, J.D.; Lane, B.G.; Post, R.S. (Massachusetts Inst. of Tech., Cambridge (USA)). Jun 1987. 21p. (NASA-CR—181004; NAS—1.26:181004). NTIS, PC A02/MF A01.

Several plasma phenomena which are to be expected around a magnet in LEO were identified and analyzed qualitatively. The ASTROMAG cusp magnet will create an extended field whose strength drops to the ambient level over a scale length of approx. 15 m; the combined field has a complex topology with ring nulls and open and closed field lines. The entire configuration is moving through the partially ionized F-layer of the ionosphere at a speed slow compared to the local Alfven speed but fast compared to the ion sound speed. The ambient plasma crosses the extended field structure in a time short compared to the ion Larmor period yet long relative to the electron Larmor period. Thus, electrons behave as a magnetized fluid while ions move ballistically until reflected from higher fields near the cusp. Since the Debye length is short compared to the field scale length, an electrostatic shock-like structure forms to equilibrate the flows and achieve quasi-neutrality. The ambient plasma will be excluded from a cavity near the magnet. The size and nature of the strong interaction region in which the magnet significantly perturbs the ambient flow were determined by studying ion orbits numerically. Lecture viewgraphs summarizing these results are presented.

44391 **(N—87-23313) Double layers in astrophysics.** Williams, A.C.; Moorehead, T.W. (National Aeronautics and Space Administration, Huntsville, AL (USA). George C. Marshall Space Flight Center). May 1987. 321p. (CONF-8603207—; NASA-CP—2469; M—560; NAS—1.55:2469). NTIS, PC A14/MF A01.

From Double layers in astrophysics conference; Huntsville, AL, USA (17 Mar 1986).

Topics addressed include: laboratory double layers; ion-acoustic double layers; pumping potential wells; ion phase-space vortices; weak double layers; electric fields and double layers in plasmas; auroral double layers; double layer formation in a plasma; beamed emission from gamma-ray burst source; double layers and extragalactic jets; and electric potential between plasma sheet clouds.

44392 (N—87-23313, pp vp) **Formation mechanisms of laboratory double layers.** Chan, C. May 1987. NTIS, PC A14/MF A01. (CONF-8603207—; NASA-CP—2469; M—560; NAS—1.55:2469).

From Double layers in astrophysics conference; Huntsville, AL, USA (17 Mar 1986).

The evolution processes of double layers were studied in a series of laboratory experiments. It was found that the existence of virtual cathode-type potential wells at the electron injection boundary was the dominant triggering mechanism. The rapid growth of the potential wells led to collisionless ion trapping and the establishment of the necessary trapped ion population. For double layers with small potential drops, collisionless ion trapping actually induced ion-ion streaming instabilities and the formation of ion phase-space vortices. In this regime, the system often exhibited relaxation-type oscillations which correspond to the disruption and the recovery of the double layers.

44393 (N—87-23313, pp vp) **Some dynamical properties of very strong double layers in a triple plasma device.** Carpenter, T.; Torven, S. (Royal Institute of Technology, Stockholm, Sweden). May 1987. NTIS, PC A14/MF A01. (CONF-8603207—; NASA-CP—2469; M—560; NAS—1.55:2469).

From Double layers in astrophysics conference; Huntsville, AL, USA (17 Mar 1986).

Dynamical properties of very strong double layers seen in a differentially pumped triple plasma device are reported. These double layers are V-shaped. The following findings are discussed: (1) Disruptions in the double layer potential and in the plasma current occur when an inductance is placed in series with the bias supply between the sources in the external circuit. These disruptions, which can be highly periodic, are the result of a negative resistance region. (2) When reactances in the circuit are minimized, the double layer exhibits a jitter motion in position approximately equal to the double layer thickness. (3) When the bias between the sources is rapidly turned on, the initial phase in the double layer formation is the occurrence of a constant electric field for the first few microseconds. First the apparatus used in all of the work is discussed and then each of the three phenomena are considered.

44394 (N—87-23313, pp vp) **Pumping potential wells.** Hershkowitz, N.; Forest, C.; Wang, E.Y.; Intrator, T. May 1987. NTIS, PC A14/MF A01. (CONF-8603207—; NASA-CP—2469; M—560; NAS—1.55:2469).

From Double layers in astrophysics conference; Huntsville, AL, USA (17 Mar 1986).

Nonmonctonic plasma potential structures are a common feature of many double layers and sheaths. Steady state plasma potential wells separating regions having different plasma potentials are often found in laboratory experiments. In order to exist, all such structures must find a solution to a common problem. Ions created by charge exchange or ionization in the region of the potential well are electrostatically confined and tend to accumulate and fill up the potential well. The increase in positive charge should eliminate the well. Nevertheless, steady state structures are found in which the wells do not fill up. This means that it is important to take into account processes which pump ions from the well. As examples of ion pumping of plasma wells, potential dips in front of a positively biased electron collecting anode in a relatively cold, low density,

multidipole plasma are considered. Pumping is provided by ion leaks from the edges of the potential dip or by oscillating the applied potential. In the former case the two-dimensional character of the problem is shown to be important.

44395 (N—87-23313, pp vp) **Laboratory investigation of potential double layers.** Leung, P. May 1987. NTIS, PC A14/MF A01. (CONF-8603207—; NASA-CP—2469; M—560; NAS—1.55:2469).

From Double layers in astrophysics conference; Huntsville, AL, USA (17 Mar 1986).

In a triple plasma device, the injection of electron current from the source chamber to the target chamber causes the formation of a potential double layer. At a low current density, the space charge of the injected current produces a virtual cathode-type potential double layer. This double layer is stable, and various wave instabilities are observed to associate with this double layer. As the current density is increased, the double layer becomes unstable, and a moving double layer results. As the current density is increased further, the enhanced ionization causes the neutralization of the space charge of the electron beam, and the beam plasma discharge is ignited.

44396 (N—87-23313, pp vp) **Experimental observation of ion-acoustic double layers in laboratory plasma.** Saxena, Y.C. May 1987. NTIS, PC A14/MF A01. (CONF-8603207—; NASA-CP—2469; M—560; NAS—1.55:2469).

From Double layers in astrophysics conference; Huntsville, AL, USA (17 Mar 1986).

Experimental results on the observation of ion-acoustic double layers in laboratory plasma are presented. In a double-plasma device, modified suitably to inject an electron beam into the target plasma, modulation of the beam through a step potential leads to excitation of ion-acoustic fluctuations. The fluctuations, growing away from the separating grids, develop into weak asymmetric ion-acoustic double layers. The observations are compared with the scenario emerging out of the computer simulations and analytical results on ion-acoustic double layers.

44397 (N—87-23313, pp vp) **New hydrodynamic analysis of double layers.** Hora, H. May 1987. NTIS, PC A14/MF A01. (CONF-8603207—; NASA-CP—2469; M—560; NAS—1.55:2469).

From Double layers in astrophysics conference; Huntsville, AL, USA (17 Mar 1986).

A genuine two-fluid model of plasmas with collisions permits the calculation of dynamic (not necessarily static) electric fields and double layers inside of plasmas including oscillations and damping. For the first time a macroscopic model for coupling of electromagnetic and Langmuir waves was achieved with realistic damping. Starting points were laser-produced plasmas showing very high dynamic electric fields in nonlinear force-produced cavitous and inverted double layers in agreement with experiments. Applications for any inhomogeneous plasma as in laboratory or in astrophysical plasmas can then be followed up by a transparent hydrodynamic description. Results are the rotation of plasmas in magnetic fields and a new second harmonic resonance, explanation of the measured inverted double layers, explanation of the observed density-independent, second harmonics emission from laser-produced plasmas, and a laser acceleration scheme by the very high fields of the double layers.

44398 (N—87-23313, pp vp) **Ion phase-space vortices and their relation to small amplitude double layers.** Pecseli, H.L. May 1987. NTIS, PC A14/MF A01. (CONF-8603207—; NASA-CP—2469; M—560; NAS—1.55:2469).

From Double layers in astrophysics conference; Huntsville, AL, USA (17 Mar 1986).

The properties of ion phase-space vortices are reviewed with particular attention to their role in the formation of small amplitude double layers in current-carrying plasmas. In a one-dimensional analysis, many such double layers simply add up to produce a large voltage drop. A laboratory experiment is carried out in order to investigate the properties of ion phase-space vortices in three dimensions. Their lifetime is significantly reduced as compared with similar results from one-dimensional numerical simulations of the problem.

44399 (N—87-23313, pp VP) **Effect of double layers on magnetosphere-ionosphere coupling.** Lysak, R.L.; Hudson, M.K. (Dartmouth College, Hanover, NH). May 1987. NTIS, PC A14/MF A01. (CONF-8603207—; NASA-CP—2469; M—560; NAS—1.55:2469).

From Double layers in astrophysics conference; Huntsville, AL, USA (17 Mar 1986).

The Earth's auroral zone contains dynamic processes occurring on scales from the length of an auroral zone field line which characterizes Alfven wave propagation to the scale of microscopic processes which occur over a few Debye lengths. These processes interact in a time-dependent fashion since the current carried by the Alfven waves can excite microscopic turbulence which can in turn provide dissipation of the Alfven wave energy. This review will first describe the dynamic aspects of auroral current structures with emphasis on consequences for models of microscopic turbulence. A number of models of microscopic turbulence will be introduced into a large-scale model of Alfven wave propagation to determine the effect of various models on the overall structure of auroral currents. In particular, the effects of a double layer electric field which scales with the plasma temperature and Debye length is compared with the effect of anomalous resistivity due to electrostatic ion cyclotron turbulence in which the electric field scales with the magnetic field strength. It is found that the double layer model is less diffusive than in the resistive model leading to the possibility of narrow, intense current structures.

44400 (N—87-23313, pp vp) **Current driven weak double layers.** Chanteur, G. May 1987. NTIS, PC A14/MF A01. (CONF-8603207—; NASA-CP—2469; M—560; NAS—1.55:2469).

From Double layers in astrophysics conference; Huntsville, AL, USA (17 Mar 1986).

Double layers in plasmas can be created by different means. For example, a potential difference forms between two plasmas with different temperatures, in a plasma jet flowing along a converging magnetic field, in a quiescent plasma submitted to an external difference of potential, or in a turbulent plasma carrying an electric charge. The first three cases can be current-free, but not necessarily, although the numerical simulations were made under such conditions for the first two points. Apart from the third case, which is mainly of interest for laboratory experiments, these double layers are good candidates for accelerating the auroral electrons to the few kiloelectron volts observed.

44401 (N—87-23313, pp vp) **Electric fields and double layers in plasmas.** Singh, N.; Thiemann, H.; Schunk, R.W. May 1987. NTIS, PC A14/MF A01. (CONF-8603207—; NASA-CP—2469; M—560; NAS—1.55:2469).

From Double layers in astrophysics conference; Huntsville, AL, USA (17 Mar 1986).

Various mechanisms for driving double layers in plasmas are briefly described, including applied potential drops, currents, contact potentials, and plasma expansions. Some dynamical features of the double layers are discussed. These features, as seen in simulations, laboratory experiments, and theory, indicate that double layers and the currents through them undergo slow oscillations which are determined by the ion transit time across an effective length of the system in which double layers form. It is shown that a localized potential dip forms at the low potential end of a double layer, which interrupts the electron current through it according to the Langmuir criterion, whenever the ion flux into the double is disrupted. The generation of electric fields perpendicular to the ambient magnetic field by contact potentials is also discussed. Two different situations were considered; in one, a low-density hot plasma is sandwiched between high-density cold plasmas, while in the other a high-density current sheet permeates a low-density background plasma. Perpendicular electric fields develop near the contact surfaces. In the case of the current sheet, the creation of parallel electric fields and the formation of double layers are also discussed when the current sheet thickness is varied. Finally, the generation of electric fields and double layers in an expanding plasma is discussed.

44402 (N—87-23313, pp vp) **Electron acceleration in stochastic double layers.** Lotko, W. May 1987. NTIS, PC A14/MF A01. (CONF-8603207—; NASA-CP—2469; M—560; NAS—1.55:2469).

From Double layers in astrophysics conference; Huntsville, AL, USA (17 Mar 1986).

Transversely localized double layers evolve randomly in turbulent regions of strongly magnetized plasma carrying current along the magnetic field. Results from numerical simulations and spacecraft observations in the auroral plasma indicate that the parallel electric field in such regions is microscopically intermittent or stochastic. The implications of stochastic double layer fields on electron acceleration will be discussed in terms of a statistical process involving ensemble averages over test particle motion. A Fokker-Planck equation can be derived for the electron phase space density, which depends on the mean and rms amplitudes of the double layers, the mean double layer density, and the initial electron velocity distribution. It is shown that the resulting electron acceleration is very sensitive to the ratio of the initial electron energy to the rms double layer amplitude. When this ratio is large, the acceleration process differs little from that expected in a dc electric field. When it is small, stochastic heating competes with directed acceleration. Evidence for both cases can be found in the auroral ionosphere in association with so-called inverted-V precipitation and collimated edge precipitation.

44403 (N—87-23313, pp vp) **Anomalous transport in discrete arcs and simulation of double layers in a model auroral circuit.** Smith, R.A. May 1987. NTIS, PC A14/MF A01. (CONF-8603207—; NASA-CP—2469; M—560; NAS—1.55:2469).

From Double layers in astrophysics conference; Huntsville, AL, USA (17 Mar 1986).

The evolution and long-time stability of a double layer (DL) in a discrete auroral arc requires that the parallel current in the arc, which may be considered uniform at the source, be diverted within the arc to charge the flanks of the U-shaped double layer potential structure. A simple model is presented in which this current redistribution is effected by anomalous transport based on electrostatic lower hybrid waves driven by the flank structure itself. This process provides the limiting constraint on the double layer potential. The flank charging may be represented as that of a nonlinear transmission line. A simplified model circuit, in which the transmission line is represented by a nonlinear impedance in parallel with a variable resistor, is incorporated in a one-dimensional simulation model to give the current density at the DL boundaries. Results are presented for the scaling of the DL potential as a function of the width of the arc and the saturation efficiency of the lower hybrid instability mechanism.

44404 (N—87-23313, pp vp) **Weak double layers in the auroral ionosphere.** Hudson, M.K.; Crystal, T.L.; Lotko, W.; Barnes, C. (Los Alamos National Lab., NM). May 1987. NTIS, PC A14/MF A01. (CONF-8603207—; NASA-CP—2469; M—560; NAS—1.55:2469).

From Double layers in astrophysics conference; Huntsville, AL, USA (17 Mar 1986).

Previous work on the evolution of weak double layers in a hydrogen plasma was extended to include H(+) and O(+) with relative drift. The relative drift between hydrogen and oxygen ions due to a quasi-static parallel electric field gives rise to a strong linear fluid instability which dominates the ion-acoustic mode at the bottom of the auroral acceleration region. This ion-ion instability can modify ion distributions at lower altitudes and the subsequent nonlinear evolution of weak double layers at higher altitudes in the ion-acoustic regime. Ion hole formation can occur for smaller relative electron-ion drifts than seen in previous simulations, due to the hydrogen-oxygen two-stream instability. This results in local modification of the ion distributions in phase space, and a partial filling of the valley between the hydrogen and oxygen peaks, which would be expected at higher altitudes on auroral field lines. The observed velocity diffusion does not necessarily preclude ion hole and double layer formation in hydrogen in the ion-acoustic regime. These simulation results are consistent with the experimentally measured persistence of separate hydrogen and oxygen peaks, and the observation of weak double layers above an altitude of 3000 km on auroral field lines.

44405 (N—87-23313, pp vp) **Particle simulation of auroral double layers.** Smith, B.L.; Okuda, H. May 1987. NTIS, PC A14/MF A01. (CONF-8603207—; NASA-CP—2469; M—560; NAS—1.55:2469).

From Double layers in astrophysics conference; Huntsville, AL, USA (17 Mar 1986).

Work on the simulation of auroral double layers (DLs) with realistic particle-in-cell models is presented. An early model simulated weak DLs formed in a self-consistent circuit but under conditions subject to the ion-acoustic instability. Recent work has focused on strong DLs formed when currentless jets are injected into a dipole magnetic field.

44406 (N—87-23313, pp vp) **Conditions for double layers in the Earth's magnetosphere and perhaps in other astrophysical objects.** Lyons, L.R. May 1987. NTIS, PC A14/MF A01. (CONF-8603207—; NASA-CP—2469; M—560; NAS—1.55:2469).

From Double layers in astrophysics conference; Huntsville, AL, USA (17 Mar 1986).

Double layers form along auroral field lines in the Earth's magnetosphere. They form in order to maintain current continuity in the ionosphere in the presence of a magnetospheric electric field E with nabla x E is not equal to 0. Features which govern the formation of the double layers are: (1) the divergence of E, (2) the conductivity of the ionosphere, and (3) the current-voltage characteristics of auroral magnetic field lines. Astrophysical situations where nabla x E is not equal to 0 is applied to a conducting plasma similar to the Earth's ionosphere are potential candidates for the formation of double layers. The region with nabla x E is not equal to 0 can be generated within, or along field lines connected to, the conducting plasma. In addition to nabla x E, shear neutral flow in the conducting plasma can also form double layers.

44407 (N—87-23313, pp vp) **Some aspects of double layer formation in a plasma constrained by a magnetic mirror.** Lennartsson, W. May 1987. NTIS, PC A14/MF A01. (CONF-8603207—; NASA-CP—2469; M—560; NAS—1.55:2469).

From Double layers in astrophysics conference; Huntsville, AL, USA (17 Mar 1986).

The shift from wave-generated anomalous resistivity toward the more large-scale effects of magnetic confinement of current carrying plasmas was inspired by the more extensive data on auroral particle distribution functions that were made available, data that may often seem consistent with a dissipation-free acceleration of auroral electrons over an extended altitude range. Efforts to interpret these data have brought new vigor to the concept that a smooth and static electric field can be self-consistently generated by suitable pitch angle anisotropies among the high altitude particle populations, different for electrons and ions, and that such an electric field is both necessary and sufficient to maintain the plasma in a quasi-neutral steady state. Certain aspects of this concept are reviewed and criticized, both from a general theoretical standpoint and from the standpoint of what is known about the magnetospheric environment. It is argued that this concept has flaws and that the actual physical problem is considerably more complicated, requiring a more complex electric field, possibly including double layer structures.

44408 (N—87-23313, pp vp) **Electric potential distributions at the interface between plasmasheet clouds.** Evans, D.S.; Roth, M.; Lemaire, J. (Institut d'Aeronomie Spatiale de Belgique, Brussels). May 1987. NTIS, PC A14/MF A01. (CONF-8603207—; NASA-CP—2469; M—560; NAS—1.55:2469).

From Double layers in astrophysics conference; Huntsville, AL, USA (17 Mar 1986).

At the interface between two plasma clouds with different densities, temperatures, and/or bulk velocities, there are large charge separation electric fields which can be modeled in the framework of a collisionless theory for tangential discontinuities. Two different classes of layers were identified: the first one corresponds to (stable) ion layers which are thicker than one ion Lamor radius; the second one corresponds to (unstable) electron layers which are only a few electron Larmor radii thick. It is suggested

that these thin electron layers with large electric potential gradients (up to 400 mV/m) are the regions where large-amplitude electrostatic waves are spontaneously generated. These waves scatter the pitch angles of the ambient plasmasheet electron into the atmospheric loss cone. The unstable electron layers can therefore be considered as the seat of strong pitch angle scattering for the primary auroral electrons.

44409 (N—87-23313, pp vp) **Double layers above the aurora.** Temerin, M.; Mozer, F.S. May 1987. NTIS, PC A14/MF A01. (CONF-8603207—; NASA-CP—2469; M—560; NAS—1.55:2469).

From Double layers in astrophysics conference; Huntsville, AL, USA (17 Mar 1986).

Two different kinds of double layers were found in association with auroral precipitation. One of these is the so-called electrostatic shock, which is oriented at an oblique angle to the magnetic field in such a way that the perpendicular electric field is much larger than the parallel electric field. This type of double layer is often found at the edges of regions of upflowing ion beams and the direction of the electric fields in the shock points toward the ion beam. The potential drop through the shock can be several kV and is comparable to the total potential needed to produce auroral acceleration. Instabilities associated with the shock may generate obliquely propagating Alfven waves, which may accelerate electrons to produce flickering auroras. The flickering aurora provides evidence that the electrostatic shock may have large temporal fluctuations. The other kind of double layer is the small-amplitude double layer found in regions of upward flowing in beams, often in association with electrostatic ion cyclotron waves. The parallel and perpendicular electric fields in these structures are comparable in magnitude. The associated potentials are a few eV. Since many such double layers are found in regions of upward flowing ion beams, the combined potential drop through a set of these double layers can be substantial.

44410 **(PB—87-196424/XAB) Data processing algorithms for inferring stratospheric gas concentrations from balloon-based solar-occultation data. Technical memo.** Chang, I.L. (National Environmental Satellite, Data, and Information Service, Washington, DC (USA)). Apr 1987. 38p. (NOAA-TM-NESDIS—31). NTIS, PC A03/MF A01.

In three high-altitude balloon experiments, the authors inferred concentrations of ozone, water vapor, and other gases in the stratosphere, using the technique of solar occultation. The objective was to demonstrate feasibility of a new technique before implementing it on a satellite, and to gain experience with handling the data. The technical report documents detail the methods developed for processing the data. It presents the equations that describe the atmospheric physics of the measurement and the algorithms to solve them. It also presents practical aspects of applying the algorithms to real data, methods for overcoming aberrations and problems inherent in the occultation technique, and sample results.

44411 **(SAND—87-0619C) Laser diagnostics of silicon chemical vapor deposition: In situ measurements and comparisons with model predictions.** Breiland, W.G.; Ho, P.; Coltrin, M.E. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 10p. (CONF-871027—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008514.

From 172. meeting of the Electrochemical Society; Honolulu, HI, USA (18 Oct 1987).

In situ measurements of gas phase temperature profiles and chemical species density profiles have been measured during the chemical vapor deposition (CVD) of silicon from silane. Laser Raman spectroscopy was used to obtain gas temperature profiles and silane density profiles, and laser-excited fluorescence was used to obtain relative density profiles of Si atoms and silicon dimers. These measurements are compared to profiles predicted by the mathematical model of Coltrin, Kee, and Miller. We give an overview of the gas-phase chemistry of this CVD process that results from the model predictions and experimental confirmations.

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REFER ALSO TO CITATION(S) 43674, 43716, 43760, 43832, 43892, 43893, 43911, 43924, 44523, 44750

44412 **(AD-A—180685/0/XAB) Windows in direct dissociative recombination cross sections. Report for November 1984-December 1985.** Guberman, S.L. (Harvard-Smithsonian Center for Astrophysics, Cambridge, MA (USA)). 1986. 7p. NTIS, PC A02/MF A01.

Pub. in Canadian Jnl. of Physics, Vol. 64, No. 12, 1621-1625(1986).

Model potential curves are used to show that large windows are present in direct dissociative-recombination cross sections from excited molecular-ion vibrational levels. The windows are due to the overlap of vibrational wave functions of the repulsive neutral states with the nodes of the ion vibrational wave functions.

44413 **(AD-A—180779/1/XAB) Revised Rydberg formula for two-electron systems. 1. (Core)ns(2).** Wang, H.T. (Naval Research Lab., Washington, DC (USA)). 1986. 11p. NTIS, PC A02/MF A01.

Pub. in Jnl. of Physics B: Atomic and Molecular Physics, Vol. 19, 3401-3410(1986).

An empirically fitted Rydberg-like formula for two-electron systems is described. The resultant revised Rydberg formula (RRF) contains two parameters: the screening constant sigma and the correction to the effective quantum number mu. They can concisely correlate a large number of (core) n/sub i/ l sq binding energies. Both are simple functions of the core charge Z, the core configuration and l. The accuracy of the RRF in calculating the two-electron binding energies of over 50 (core)n/sub i/ sq species is demonstrated, and the physical interpretations of sigma/sub s/ and mu/sub s/ are discussed.

44414 **(CEA-CONF—8329) Use of pseudopotentials in atom-atom (or molecule) collisions.** Pascale, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Fondamentale (IRF)). Sep 1985. 58p. (CONF-8509387—1). NTIS (US Sales Only), PC A04/MF A01. File Number DE87752218.

From 13. summer school on quantum optics; Frombork, Poland (2 Sep 1985).

Knowledge of interactions between ions, atoms or molecules is fundamental for interpretating or predicting collisional processes which may occur under various circumstances. The aim of this paper is to demonstrate the usefulness of using semiempirical effective interactions (more particularly, emphasis will be put on the pseudopotential approach) in the study of atom-atom (or molecule) collisions. We would like to show that if the semiempirical effective interactions are carefully defined, their use in molecular-structure calculations and in collision problems can give quite accurate results. We will limit our examples to one-electron systems. We consider the M-atom-He systems as a first example. For these systems, recent molecular-structure calculations have been carried out using an l-dependent semiempirical pseudopotential approach and they have been tested against numerous experimental data in extensive calculations of cross sections for intra-and-inter-doublet transitions in the M-atom in collisions with He. Our second example will concern the M-H/sub 2/ systems, for which semiempirical pseudopotential molecular-structure calculations have been performed very recently using an one-electron two-center model. The results of these calculations are quite encouraging and we foresee the use of the pseudopotential approach in future studies of some reactive scattering processes.

44415 **(CEA-CONF—8554) AC-stark shifts in resonant multiphoton ionization.** Agostini, P.; Petite, G.; L'huiller, A.; Lambropoulos, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Fondamentale (IRF)). Sep 1986. 3p. (CONF-8609132—15-Summ.). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752199.

From Resonance ionization spectroscopy and its application; Swansea, UK (7 Sep 1986).

Published in summary form only.

44416 **(CONF-8706176—1) Dielectronic recombination measurements of multicharged ions.** Dittner, P.F. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011671.

From Workshop and symposium on the physics of low energy, stored, and trapped particles; Stockholm, Sweden (14 Jun 1987).

Dielectronic recombination rates have been measured for several charge states of isoelectronic Li-like, Be-like, B-like, and Na-like ions. The amount of electron capture attending the passage of MeV/nucleon ion beams through a collinear, magnetically confined space-charge-limited electron beam as a function of relative energy has been observed. The experimental rates are consistent in magnitude and shape with rates determined from distorted-wave calculations of the dielectronic-recombination cross sections. 72 refs., 6 figs.

44417 **(DOE/ER/00038—3004) An overview of the oxidation of ferrous ions in the Fricke dosimeter by heavy ions.** LaVerne, J.A.; Schuler, R.H. (Notre Dame Univ., IN (USA). Radiation Lab.). 1987. Contract AC02-76ER00038. 6p. (CONF-870701—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012205.

From 8. international congress of radiation research; Edinburgh, UK (19 Jul 1987).

The Fricke dosimeter, a widely used chemical dosimeter, is well understood in terms of the oxidation of ferrous ion in 0.8 N sulfuric acid solution by H atoms (via production of HO_2), OH radicals and H_2O_2 (Allen, 1961). The production of ferric ion is most sensitive to radical yields, especially H atoms, and is considerably less for heavy ions than for fast electrons. This difference is due to the increased importance of intratrack processes which enhance radical-radical recombination reactions producing molecular products as the linear energy transfer (LET = -dE/dx, i.e., stopping power) increases. The literature contains extensive data on radiolysis of the Fricke dosimeter with heavy ions, however, most of these studies were done with protons or alpha particles where the LET is relatively low (LaVerne and Schuler, 1987). These data are summarized here and combined with our own studies using ^{4}He, ^{7}Li, ^{9}Be, ^{11}B, and ^{12}C ions with energies up to 35 MeV. Differential yields are determined for these particles at specific energies and their dependence on track structure is discussed.

44418 **(DOE/ER/13171—T1) Spectroscopic diagnostics of electron-atom collisions: Final report for period February 1, 1984-April 30, 1987.** Gallagher, A. (Colorado Univ., Boulder (USA)). Apr 1987. Contract AC02-84ER13171. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013030.

A new method of measuring differential electron excitation cross section has been developed and tested on the Na 3S-3P transition. An apparatus was constructed and all elements achieved operation at or above design criteria. Excellent Signal to Noise Levels were achieved and cross sections with respect to M/sub L/ and M/sub S/ changes were measured. The feasibility of making these measurements also differential in electron scattering angle was demonstrated, and such measurements were initiated. This method is uniquely capable of measuring fully differential cross sections for exciting metal atoms, and it is particularly effective in the threshold energy region of primary interest.

44419 **(DOE/ER/40150—30) High energy polarized electron beams.** Rossmanith, R. (Continuous Electron Beam Accelerator Facility, Newport News, VA (USA)). 22 Jun 1987. Contract AC05-84ER40150. 17p. (CEBAF-R—87-002). NTIS, PC A02/MF A01; GPO Dep. File Number DE87012465.

In nearly all high energy electron storage rings the effect of beam polarization by synchrotron radiation has been measured. The buildup time for polarization in storage rings is of the order of 10^{6} to 10^{7} revolutions; the spins must remain aligned over this time in order to avoid depolarization. Even extremely small spin deviations per revolution can add up and cause depolarization. The injection and the acceleration of polarized electrons in linacs is much easier. Although some improvements are still necessary, reliable polarized electron sources with sufficiently high intensity and polarization are available. With the linac-type machines SLC at Stanford and CEBAF in Virginia, experiments with polarized electrons will be possible.

44420 (INIS-BR—712, pp 116-127) **Inner shell ionization by charged particles-theoretical and experimental aspects.** Montenegro, E.C. (Pontificia Univ. Catolica do Rio de Janeiro, Brazil. Dept. de Fisica). 1985. (In Portuguese). NTIS (US Sales Only), PC A12/MF A01. File Number DE87703464. (CONF-8508241—).

From 8. workshop on nuclear physics; Sao Lourenco, MG, Brazil (31 Aug 1985).

Some processes, more significant, which occur in slow ion-atom collisions causing inner-shell ionization are qualitatively described. Both, theoretical and experimental aspects are discussed. (L.C.).

44421 (INIS-BR—712, pp 128-150) **Interface between the nuclear physics and the atomic physics; how to measure nuclear times observing atomic transitions.** Pinho, A.G. de. (Pontificia Univ. Catolica do Rio de Janeiro, Brazil. Dept. de Fisica). 1985. (In Portuguese). NTIS (US Sales Only), PC A12/MF A01. File Number DE87703464. (CONF-8508241—).

From 8. workshop on nuclear physics; Sao Lourenco, MG, Brazil (31 Aug 1985).

Recent observations are related in which processes resulting from the ionization in ion-atom collisions are observed in coincidence with nuclear processes (where the incidence ion nucleus hits the target atom nucleus). The delay introduced by the nuclear reaction contaminates the results of the atomic collision and manifest itself either in the X rays (positrons) emitted in the joined atom system or in the X rays (Auger electrons) emitted by separeted atoms, after the collision. Both effects serve to obtain information on the reaction times (in general much less then 10/sup -16/ sec). Following this line, other experimental possibilities are discussed. (L.C.).

44422 **(INIS-mf—10642) Study of the multiple ionization in the ion-atom collisions with highly charged sulfur as well as with neutral and lowly charged fluorine projectiles.** Konrad, J. (Heidelberg Univ. (Germany, F.R.). Naturwissenschaftlich-Mathematische Gesamtfakultaet). 1986. 90p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE87752445.

With the collisional systems 115 MeV S/sup +Q/ (Q=+13, +15, +16) on He, Ne, Ar, and Kr as well as 4 MeV F/sup +Q/ (Q=-1, 0, +1) on Ne the multiple ionization in the ion-atom collision was studied. With the collisional system 4 MeV F/sup +Q/ on Ne the multiple ionization of target and projectile was studied by coincidence measurement between the recoil ions and projectiles with the charge state Q' after the collision (Q'=-1 to +3). In the pure ionization (no change of the projectile charge) the measured ionization cross sections for the single positive and negative charged projectile are equally large, those of the neutral F projectiles are lower. The comparison with the point particles protons and electrons resulted that the ionization cross sections of the F projectiles are larger and more strongly higher charged recoil ions are produced. The measured ionization cross sections of the F projectile are larger than those of the Ne target atom which is to be reduced to the lower ionization energies of the F projectile. With the highly charged S projectiles the multiple ionization with capture into the projectile was studied. By the measurement of triple coincidcences between recoil ions, projectiles, and SKX-radiation the cases with and without capture into the K shell can be discriminated. The charge distribution with is shifted against that without capture into the K shell to higher charges. This shift is to be reduced to the decay of autoionization states which arise by the capture into the K shell. (orig./HSI).

44423 (IPPCZ—253, pp 42-53) **Generation of high-current pulsed beams of negative ions.** Agafonov, A.V.; Kolomenskij, A.A.; Lebedev, A.N.; Logachev, I.I.; Mikhalev, P.S.; Mozgovoj, A.G.; Orlov, D.B.; Papadichev, V.A.; Shelkovenko, T.A. (AN SSSR, Moscow. Fizicheskij Inst.). Sep 1985. (In Russian). NTIS (US Sales Only), PC A06/MF A01. File Number DE87702604. (CONF-8505358—).

From 13. Czechoslovak seminar on plasma physics and technology; Liblice, Czechoslovakia (13 May 1985).

The advanced high-power pulse technology, now widely used for the production of high-current electron and proton beams, may also be used for generating high-current beams of negative ions. The presented theoretical estimates show that with magnetically insulated diodes, currents of negative hydrogen ions can be achieved comparable with the space-charge limit. The production of negative ions was studied experimentally in the ERG and Impul's accelerators. Negative ion currents as high as 5 kA and current densities up to 40 kA/cm/sup 2/ were produced. The diagnostic methods used and the results of an investigation of cathode plasma production are discussed in detail. (J.U.).

44424 **(JAERI-M—87-053) Grotrian diagrams for the hydrogen I isoelectronic sequence, H I through Kr XXXVI.** Funatake, Yoshio; Shirai, Toshizo; Nakai, Yohta. (Japan Atomic Energy Research Inst., Tokyo). Mar 1987. 143p. NTIS (US Sales Only), PC A07/MF A01. File Number DE87752987.

It is useful for finding out systematic trends in atomic transitions to survey spectral lines of ions in isoelectronic sequences. In this report, Grotrian diagrams are presented to provide graphical overviews in the hydrogen I isoelectronic sequence.

44425 **(LA-UR—87-2078) Search for spontaneous conversion of muonium to antimuonium.** Hughes, V.W.; Ni, B.; Arnold, K.P.; Chmely, F.; Kettell, S.H.; Kuang, Y.; Markey, J.; Matthias, B.E.; Orth, H.; Schaefer, H.R. (Yale Univ., New Haven, CT (USA); Los Alamos National Lab., NM (USA); College of William and Mary, Williamsburg, VA (USA); Mississippi Univ., University (USA); Heidelberg Univ. (Germany, F.R.)). 1987. Contract W-7405-ENG-36. 17p. (CONF-870413—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011767.

From 11. international conference on particles and nuclei; Kyoto, Japan (20 Apr 1987).

We have searched for spontaneous conversion of muonium (M) to antimuonium M bar by a method involving detection of high-Z muonic X rays. A beam of M atoms with keV energies, produced by electron pickup by μ^+ from a foil, travels in vacuum and in a magnetic field-free environment to a high-Z target. The event signatures used were a double coincidence of two muonic X rays of the target material and a triple coincidence that also required detection of secondary electrons ejected when M strikes the target. Partial analysis of our 8 x 10^6 triggers indicates upper limits on the effective M →M bar four-dermion coupling constant of G/sub MM bar/ ≦ 30 G/sub F/ (90% C.L.) and G/sub MM bar/ ≦ 8 G/sub F/ (90% C.L.), respectively, from the two signatures. This begins to probe predictions of the left-right symmetric theory with a doubly-charged Higgs triplet.

44426 **(LA-UR—87-2153) Recent LAMPF [Los Alamos Meson Physics Facility] research using muons.** Bradbury, J.N. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 13p. (CONF-8706161—1). NTIS, PC A02. File Number DE87011739.

From 2. international conference on muon and pion interactions in matter; Dubna, USSR (30 Jun 1987).

In addition to the core programs in nuclear and particle physics, diverse experiments have been carried out that address interdisciplinary and applied topics at the Los Alamos Meson Physics Facility (LAMPF). These include muon-spin-relaxation experiments to study magnetic dynamics in spin glasses and electronic structure in heavy-fermion superconductors; muon channeling experiments to provide information on pion stopping sites in crystals; tomographic density reconstruction studies using proton energy loss; and radiation-effects experiments to explore microstructure evolution and to characterize materials for fusion devices and high-intensity accelerators. Finally, the catalysis of the d-t fusion reaction using negative muons has been extensively investigated with some surprising results including a stronger than linear dependence of the mesomolecular formation rate on target density and the observation of 150 fusions per muon under certain conditions. Recent results in those programs involving pions and muons interacting with matter are discussed.

44427 **(LA-UR—87-2249) Ab initio methods for electron-molecule collisions.** Collins, L.A.; Schneider, B.I. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 26p. (CONF-870715—1). NTIS, PC A03/MF A01; GPO Dep. File Number DE87011728.

From 15. international conference on the physics of electronic and atomic collisions; Brighton, UK (22 Jul 1987).

This review concentrates on the recent advances in treating the electronic aspect of the electron-molecule interaction and leaves to other articles the description of the rotational and vibrational motions. Those methods which give the most complete treatment of the direct, exchange, and correlation effects are focused on. Such full treatments are generally necessary at energies below a few Rydbergs (≃ 60 eV). This choice unfortunately necessitates omission of those active and vital areas devoted to the development of model potentials and approximate scattering formulations. The ab initio and model approaches complement each other and are both extremely important to the full explication of the electron-scattering process. Due to the rapid developments of recent years, the approaches that provide the fullest treatment are concentrated on. 81 refs.

44428 **(LA-UR—87-2313) Recent advances in the theory of electron impact excitation of molecules.** Collins, L.A.; Schneider, B.I. (Los Alamos National Lab., NM (USA)). Jul 1987. Contract W-7405-ENG-36. 23p. (CONF-870715—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013148.

From 15. international conference on the physics of electronic and atomic collisions; Brighton, UK (22 Jul 1987).

This paper presents a theoretical discussion of electronic excitations of molecules. 55 refs. (JDH)

44429 **(N—87-22024) Parametrization of electron impact ionization cross sections for CO, CO_2, NH_3 and SO_2.** Srivastava, S.K.; Nguyen, H.P. (Jet Propulsion Lab., Pasadena, CA (USA)). Apr 1987. 84p. (NASA-CR—180913; JPL-PUB—87-2; NAS—1.26:180913). NTIS, PC A05/MF A01.

The electron impact ionization and dissociative ionization cross section data of CO, CO_2, CH_4, NH_3, and SO_2, measured in the laboratory, were parameterized utilizing an empirical formula based on the Born approximation. For this purpose an chi squared minimization technique was employed which provided an excellent fit to the experimental data.

44430 **(N—87-22477) Near Hartree-Fock quality GTO basis sets for the second-row atoms.** Partridge, H. (National Aeronautics and Space Administration, Moffett Field, CA (USA). Ames Research Center). May 1987. 78p. (NASA-TM—89449; A—87178; NAS—1.15:89449). NTIS, PC A05/MF A01.

Energy optimized, near Hartree-Fock quality Gaussian basis sets ranging in size from (17s12p) to (20s15p) are presented for the ground states of the second-row atoms for Na(2P), Na(+), Na(-), Mg(3P), P(-), S(-), and Cl(-). In addition, optimized supplementary functions are given for the ground state basis sets to describe the negative ions, and the excited Na(2P) and Mg(3P) atomic states. The ratios of successive orbital exponents describing the inner part of the 1s and 2p orbitals are found to be nearly independent of both nuclear charge and basis set size. This provides a method of obtaining good starting estimates for other basis set optimizations.

44431 **(UCID—21076) The polarization field for pulsed Raman transitions.** Shore, B.W.; Sacks, R.; Karr, T. (Lawrence Livermore National Lab., CA (USA)). 15 May 1987. Contract W-7405-ENG-48. 25p. NTIS, PC A02. File Number DE87013118.

This memo discusses the induced polarization field that occurs in the presence of Raman processes, and the propagation equations that result from this field. First the paper summarizes the relationship between the macroscopic polarization field and the microscopic dipole-moment expectation value. It summarizes expressions for the induced dipole moment that result from the adiabatic elimination of non-resonant molecular transitions, to produce an effective two-photon (Raman) Hamiltonian. Then it shows that the polarization field has a similar mode expansion to the electric field. Using this result the equations for pulse propagation of the electric field are described. These equations involve a generalized gain matrix and mode velocity, as well as a refractive index, each of which depends upon position and time. Finally the paper summarizes these results and exhibits succinctly the pulse propagation equations in the plane-wave slowly-varying envelope approximation. The equations presented here must be supplemented with excitation equations (or by steady-state results) for the molecules. The material presented here is a portion of a more extensive treatment of propagation to be presented separately.

44432 **(UCID—21103) Theory of atoms in strong, pulsed electromagnetic fields: 2, A free electron and a harmonically bound electron.** Szoeke, A.; Garrison, J. (Lawrence Livermore National Lab., CA (USA)). Jul 1987. Contract W-7405-ENG-48. 25p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87012571.

Multiple scale methods are used to treat several ingredients of the theory of atoms in strong electromagnetic fields. First, a focused electromagnetic field is expanded. Second, a classical electron is described giving the ponderomotive potential. Third, the quantum electron is treated in the WKB approximation. Fourth, the one dimensional quantum harmonic oscillator is solved; and last the one dimensional square well, showing the low intensity limit of the theory.

44433 **(UCRL—96913) Electronic excitation and ion source optimization.** Hiskes, J.R.; Lietzke, A.F. (Lawrence Livermore National Lab., CA (USA); Lawrence Berkeley Lab., CA (USA)). 29 Jun 1987. Contract W-7405-ENG-48. 23p. (CONF-870787—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012240.

From International Atomic Energy Agency technical committee meeting on negative ion beam sources; Culham, UK (15 Jul 1987).

The electronic excitation cross sections leading to $H_2(v'')$ molecules are discussed. The effect of shortening the length of the first chamber of a tandem configuration for the purpose of reducing the atomic concentration is shown to enhance the extracted current density.

44434 **Remarks about fields of high intensity.** Teller, E. (Lawrence Livermore National Lab., CA). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **24/25**: No. 1, 1-2(Apr 1987). (CONF-861114—).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

At high field strength any known material will break down by the production of electrons and ions. At a higher field strength, massive production of pairs will occur. This phenomenon is discussed when heavy ions of $\gamma \simeq 100$ collide. Even when the heavy ions approach to within one nuclear radius, pair production involving electrons and mesons must be expected. High magnetic fields between the nuclei might be coupled to pairs of magnetic monopoles.

44435 **Atomic physics experiments with stored cooled heavy ion beams.** Datz, S. (Oak Ridge National Lab., TN). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **24/25**: No. 1, 3-10(Apr 1987). (CONF-861114—).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

The wide ranging interest in the development of heavy ion synchrotrons with electron beam cooling is evident from the number of projects presently under way. Although much of the initial motivation for these rings stemmed from nuclear and particle physics, a considerable amount of atomic physics experimentation is planned. This paper surveys some of the new opportunities in atomic physics which may be made available with storage ring systems.

44436 **Electron capture in ion-molecule collisions at intermediate energy.** Kimura, M. (Argonne National Lab., IL; Rice Univ., Houston, TX). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **24/25**: No. 1, 101-105(Apr 1987). (CONF-861114—). Contract W-31-109-ENG-38.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Recent progress in theoretical studies on charge transfer in ion-molecule collisions at the intermediate energy is reviewed. Distinction between close and distant collisions is crucial to the understanding of charge transfer processes, as it is in many aspects of ion-atom collisions. For a close collision, explicit representation of the whole collision complex is necessary to describe the collision dynamics correctly, while a model potential approach for the molecule is appropriate for a distant collision. It is shown that these two distinct points of view are necessary for reproducing experimental charge transfer cross sections. Some remarks concerning further theoretical study of ion-molecule collisions are also given.

44437 **Recent studies of simultaneous ionization and charge transfer in helium ion-atom collisions.** DuBois, R.D. (Battelle Pacific Northwest Labs., Richland, WA). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **24/25**: No. 1, 209-213(Apr 1987). (CONF-861114—). Contract AC06-76RL01830.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

In our laboratory, we are interested in ionization of atomic and molecular targets induced by light ion impact. Generally these collisions are studied by monitoring the ejected electron spectra with the assumption that each ionizing event leads to a single secondary electron. By measuring the target ionization charge states produced by directly ionizing and charge changing collisions, we have obtained cross sections for direct ionization, pure charge transfer, and charge transfer plus ionization thus making it possible to distinguish how target ionization occurs. It was found that charge transfer plus ionization can sometimes be more probable than pure charge transfer alone. This is important because one mechanism which has until recently been disregarded as a means of producing free electrons is the possibility of capturing an electron from the target and simultaneously ionizing one or more target electrons. For ion impact velocities comparable to, or less than, the outer shell bound electron velocities, we have found that charge transfer plus ionization can be a substantial, if not principal, means of producing free electrons.

44438 **Measured multipole moments of continuum electron transfer angular distributions.** Elston, S.B. (Tennessee Univ., Knoxville; Oak Ridge National Lab., TN). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **24/25**: No. 1, 214-218(Apr 1987). (CONF-861114—). Contract AC05-84OR21400.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

The velocity space distribution of electrons emitted near the forward direction from collisions involving fast, highly stripped oxygen ions with gaseous and solid targets is presented and described in terms of multipole moments of the ejected charge distribution, which permits direct comparison with recent theory. The measurements are produced by employing position-sensitive electron detection to combine emission angle definition with conventional electrostatic spectrometry. Agreement obtained between theory and distributions observed for binary continuum electron loss processes coupled with a similar multipole content observed with solid targets suggests a model of convoy electron production

dominated by electron loss from the projectile within the bulk of the target. Further, the connection between multipoles of the projectile electron emission distribution in single collisions and the state of excitation of that projectile excited states may provide the basis for a probe of the state of ions traversing bulk solid mattter.

44439 **Calculations of coincident ionization plus excitation.** Becker, R.L. (Oak Ridge National Lab., TN). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **24/25**: No. 1, 256-260(Apr 1987). (CONF-861114—). Contract AC05-84OR21400.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

For Li- nd Be-like ions, K X-ray yields, together with detection that the ionic charge has increased, give the cross section for ionization plus excitation (IE), a process which can exhibit electron-electron correlations. Measurements of IE for $_{14}Si^{11+}$ + He stimulated our coupled-channels calculations in the independent-Fermi-particle model (IFPM), which includes Pauli correlations. We discuss how the IFPM expressions, generalized here to include an open shell, differ from those for distinguishable electrons. The sensitivity of σ/sub IE/ to correlations is shown. Recent additional measurements and future ones giving excitation functions for resolved configurations and complementary Auger data will provide even more sensitive tests of collisional correlation theory.

44440 **Simple formula for the energies of doubly excited states.** Lin Chiidong; Watanabe, S. (Argonne National Lab., IL; Observatoire de Paris, Section de Meudon, 92, France). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **24/25**: No. 1, 284-287(Apr 1987). (CONF-861114—). Contract W-31-109-ENG-38.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

A simple formula for the energy levels of doubly excited states of atoms and multiply charged ions is derived and expressed in terms of a set of new correlation quantum numbers. The accuracy of the formula is checked by comparing with the results from other elaborate calculations. Modification of the formula for doubly excited states of multielectron atoms are also presented.

44441 **Angular distributions of very low energy recoil ions.** Gonzalez Lepera, C.E.; Breinig, M.; Burgdoerfer, J.; DeSerio, R.; Elston, S.B.; Gibbons, J.P.; Huelskoetter, H.P.; Liljeby, L.; Short, R.T.; Vane, C.R. (Tennessee Univ., Knoxville; Oak Ridge National Lab., TN). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **24/25**: No. 1, 316-320(Apr 1987). (CONF-861114—). Contract AC05-84OR21400.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

We present the first measurements of the angular distribution of recoil ions near 90° with respect to the incident projectile direction. Beams of 22.5 and 33 MeV chlorine ions (incident charge states q = 4, 5, 8) have been used as hammer beams incident on Ne atoms. We do not confirm the long standing assumption that these recoil ions are ejected preferentially at angles very near 90° with respect to the primary beam direction, although they do have energies typically less than 5 eV. Recoil ions ejected around 90° have an energy distribution appreciably wider than those ejected at either larger or smaller angles.

44442 **Autodetachment spectroscopy of metastable negative ions.** Kvale, T.J.; Alton, G.D.; Compton, R.N.; Thompson, J.S.; Pegg, D.J. (Oak Ridge National Lab., TN; Tennessee Univ., Knoxville). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **24/25**: No. 1, 325-328(Apr 1987). (CONF-861114—). Contract FG05-85ER13456;AC05-84OR21400.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

This paper is a review of some of our recent measurements on the metastable negative ions, Be^- and He_2^-, using the technique of fast-beam autodetachment spectroscopy.

6404 Fluid Physics

REFER ALSO TO CITATION(S) 43677, 43778, 43814, 43859, 44649

44443 **(AD-A—181065/4/XAB) Analytical investigation of plasma and electrode potentials in a diode-type r-f (radio-frequency) discharge.** Suzuki, K.; Ninomiya, K.; Nishimatsu, S.; Thoman, J.W.; Steinfeld, J.I. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Chemistry). Oct 1986. 7p. NTIS, PC A02/MF A01.

Pub. in Japanese Jnl. of Applied Physics, Vol. 25, No. 10, 1569-1574(Oct 1986).

Electrical potentials of a plasma and both electrodes in a diode-type r-f discharge are analytically obtained under the assumptions of quasi-static electric fields in an ion sheath, low gas pressure, charge neutrality of the plasma, and eta $<<1$ (eas is the ratio of electrode areas). The dependence of dV/sub p/ D/dU/sub p/ (V/sub p/ D and U/sub p/ are the d-c part of the plasma potential and the potential difference between the plasma and the r-f power electrode, respectively) on eta is, then, compared with experimental results. The following conclusions are found: 1. The plasma potential does not necessarily have a simple harmonic form, even if the supplied RF power has that form. 2. The DC parts of the plasma potential and the RF power electrode potential change depending on the waveform of the supplied RF power, even if the RF amplitude and eta are kept constant. 3. -dV/sub p/ D/dU/sub p/ depends quadratically on eta, with a proportionality constant K which depends on the waveform of the supplied r-f power.

44444 **(DOE/ER/13044—9) On the upper critical dimension of Bernoulli percolation.** Chayes, J.T.; Chayes, L. (Cornell Univ., Ithaca, NY (USA). Lab. for Atomic and Solid State Physics). [1987]. Contract AC02-83ER13044. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012412.

Derived is a set of inequalities for the d-dimensional independent percolation problem. Assuming the existence of critical exponents, these inequalities imply: f + nu $\geq$ 1 + β/sub Q/, μ + nu $\geq$ 1 + β/sub Q/, zeta $\geq$ min (1, nu'/nu), where the above exponents are f: the flow constant exponent, nu (nu'): the correlation length exponent below (above) threshold, μ: the surface tension exponent, β/sub Q/: the backbone density exponent and zeta: the chemical distance exponent. Note that all of these inequalities are mean-field bounds, and that they relate the exponent nu defined from below the percolation threshold to exponents defined from above threshold. Furthermore, we combine the strategy of the proofs these inequalities with notions of finite-size scaling to derive: max (d nu, d nu') $\geq$ 1 + β/sub Q/, where d is the lattice dimension. Since β/sub Q/ $\geq$ 2β, where β is the percolation density exponent, the final bound implies that, below six dimensions, the standard order parameter and correlation length exponents cannot simultaneously assume their mean-field values; hence an implicit bound on the upper critical dimension: d/sub c/ $\geq$ 6.

44445 **(DOE/ER/53194—T3) Nonlinear magnetohydrodynamics: The effects of nonlinear plasma fluctuations on the transport, confinement, and heating of a plasma: [Annual] progress report for period July 1, 1986-July 1, 1987.** Montgomery, D.C. (Dartmouth Coll., Hanover, NH (USA). Dept. of Physics and Astronomy). Jul 1987. Contract FG02-85ER53194. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012459.

The three principal areas of research reported are: (1) turbulent relaxation processes in current carrying magnetofluids such as the reversed-field-pinch; (2) density fluctuations in compressible MHD turbulence; and (3) development of plasma cellular automata, lattice-gas models of magnetofluids and Vlasov plasmas which show promise as a future computational tool. This paper presents a brief description of the results obtained.

44446 **(DOE/ET/53088—270) Two-dimensional shear flow turbulence: A statistical theory of vortex filaments.** Chiueh, T.; Terry, P.W.; Diamond, P.H. (Colorado Univ., Boulder (USA). Dept. of Astrophysical, Planetary, and Atmospheric Sciences; Texas Univ., Austin (USA). Inst. for Fusion Studies). May 1987. Contract FG05-80ET53088. 42p. (IFSR—270). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012234.

A theory of two-dimensional free shear flow turbulence is proposed. In particular, the role of interactions of fluctuations with the mean flow is distinguished from that of interactions among fluctuations. The former are responsible for the extraction of free energy necessary for maintaining the turbulence, while the latter lead to the enstrophy cascade which generates small-scale eddies. On the length scales of greatest interest, turbulence is anisotropic because of the influence of mean flow shear. At smaller scales, self-similar enstrophy transfer occurs and yields the familiar power law spectrum. Free energy extraction is accompanied by mean flow relaxation. Two distinct mechanisms are involved. In addition to the usual quasilinear diffusion, there is a nonlinear drift which acts to enhance localized fluctuations and flatten the mean flow profile. The saturated state is characterized by collective resonances which must be nonlinearly damped in order to balance their generation by seed-eddy induction. This balance gives rise to a condition for the determination of the nonlinear damping rate, and thus the turbulence level. The spatial structure of the saturated fluctuations is also predicted.

44447 (INIS-mf—10918, pp 18-19) **Air shock wave propagation and dust entrainment near soil surfaces.** Rosenblatt, M.; Lee, H.N. (California Research and Technology Inc., Chatsworth, CA, USA). 1986. NTIS (US Sales Only), PC A03/MF A01. File Number DE87780149. (CONF-8606316—Absts.).

From 6. Mach reflection symposium; Beer Sheva, Israel (29 Jun 1986).

44448 (IPPCZ—253, pp 3-6) **Physics of the low-temperature plasma in Czechoslovakia.** Kracik, J. (Ceske Vysoke Uceni Technicke, Prague, Czechoslovakia). Sep 1985. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702604. (CONF-8505358—).

From 13. Czechoslovak seminar on plasma physics and technology; Liblice, Czechoslovakia (13 May 1985).

A survey is given of low-temperature plasma research in Czechoslovakia since 1954 and its main results are pointed out. In the first years, various processes in electric discharges and electromagnetic acceleration of plasma clusters were studied at Czechoslovak universities and in the Institute of Physics. In the study of ionization waves, Czechoslovak physicists achieved world priority. Later on, low-temperature plasma investigation began in the Institute of Plasma Physics, founded in 1959. The issues of plasma interaction with the solid state and plasma applications in plasma chemistry were studied mainly by its Department of Applied Plasma Physics. The main effort of this group, transferred recently to the Institute of Physics, is aimed at thin film production and plasma-surface interactions; similar experimental studies are also carried out at universities in Brno and Bratislava. Last but not least, arc spraying of powder materials using water-cooled plasmatrons is being developed by the Department of Plasma Technology of the Institute of Plasma Physics. (J.U.).

44449 **(LA-UR—87-2052) Fundamentals of numerical magnetohydrodynamics.** Brackbill, J.U. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 17p. (CONF-8706150—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87011769.

From International school of space simulation; La Londe les Maures, France (15 Jun 1987).

Magnetohydrodynamics is a fluid model for the motion of an ionized gas in a magnetic field. In its ideal, non-dissipative form, the Lundquist equations, it has the same mathematical character as the model for gas dynamics. It gives, in the same way, a self-consistent description of the fluid dynamics, including the exchange of momentum and energy between the field and the fluid. However, because of the greater complexity of the physics which they describe, some aspects of the solutions are quite different. The magnetic field introduces a strong anisotropic character to the medium which causes wave propagation to depend on the direction of propagation with respect of the magnetic field. In addition, there are several distinct speeds so that, in general, the responses to disturbances are quite complex. To capture the principal features of the solutions in numerical calculations, several problems must be addressed. Some of these problems are unique to MHD: for example, preserving the solenoidality of the magnetic field. Others are similar to ordinary gas dynamics, such as energy conservation, numerical stability, and computational diffusion, but are more complex or have different consequences for MHD than for ordinary fluid flow. These fundamental problems in the numerical solution of the MHD equations are discussed as four topics: the dispersion of the Lundquist equations and the dispersion and stability of finite difference approximations; the conservation laws of MHD and the achievement of conservation in the numerical solutions; a discussion of convective transport and its role in computational diffusion; and finally, a method for preserving the solenoidality of the magnetic field.

44450 **(LBL—23195) Channeling characteristics of flow and solute transport through a rough-surfaced fracture.** Tsang, Y.W.; Tsang, C.F.; Hale, F.V.; Moreno, L.; Neretnieks, I. (Lawrence Berkeley Lab., CA (USA); Royal Inst. of Tech., Stockholm (Sweden). Dept. of Chemical Engineering). Jun 1987. Contract AC03-76SF00098. 53p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87013970.

Calculations for the flow and solute transport through a single rough-surfaced fracture are carried out. The fracture plane is discretized into square meshes to which variable apertures are assigned. The spatially varying apertures in the single fractures are generated using geostatistical methods, based on a given aperture density distribution and a specified spatial correlation length. Constant head boundary conditions are assumed for the flow in the single fracture. The fluid potential at each mesh intersection is computed and the steady state flowrates between all adjacent meshes are obtained. The calculations for flow in two-dimensions show that fluid flows unevenly in a single fracture, and that it takes place in a few preferred paths. The solute transport is calculated using a particle tracking method. The channeling characteristics of fluid flow and solute transport phenomena as a function of the fracture geometry (aperture density distribution and spatial correlation length) is demonstrated; and the implication to experimental measurements are discussed. The two-dimensional solute transport results are then interpretated in terms of a one-dimensional channel model: a system of independent variable-aperture channels acting as flow paths for the solute transport. The result that the two-dimensional breakthrough curves are reproducible by the one-dimensional conceptual model sheds much light on the potential utility of the simple one-dimensional channel model to interpret flow and solute transport in both two- and three-dimensional fractured systems. This approach entails an enormous saving of computation effort.

44451 **(LBL—23698) The role of long-range forces in the formation of thin liquid films on metals.** Gyory, J.R.; Muller, R.H. (Lawrence Berkeley Lab., CA (USA)). Jun 1987. Contract AC03-76SF00098. 212p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE87014133.

White-light multiple beam interference is used to study the drainage of aqueous electrolytes from vertically optically smooth platinum and gold plates. Bulk liquid is in contact with the bottom of the metal plate. For short times following the lowering of the bulk liquid level, the change in the film profile agrees with that expected from viscous drainage. However, at long times, the film profile deviates from that expected and eventually becomes independent of time at a thickness between 0.08 and 0.25 micrometers. These profiles are best represented by a function dependent on the inverse cube root of height. The thickness of the equilibrium film profiles with increasing electrolyte concentration. A model based on long range van der Waals interactions resulting in a repulsive force between the interfaces of the film is shown to predict the correct profile shape, and for dilute electrolytes, the correct film thickness. This model also predicts increasing film thickness for increasing electrolyte concentration. The strength of this interaction is characterized by the Hamaker constant which can be calculated from the dielectric functions evaluated at imaginary frequencies of the film

and substrate. For metals, this function is generated from spectral absorption data, limiting behavior for low and high frequencies, and by use of the Kramers-Kronig transformation. Hamaker constants calculated from the dielectric functions generated in this manner agree well with those derived from film profiles for dilute electrolytes.

44452 **(PB—87-196234/XAB) Anisotropy of ion mobility and the superfluid energy gap in ^{3}He-A.** Salmelin, R.H.; Salomaa, M.M. (Helsinki Univ. of Technology, Espoo (Finland). Low Temperature Lab.). Feb 1987. 19p. (TKK-F-A—607). NTIS, PC PC E03/MF E01.

A numerically superior new scheme is introduced to evaluate the mobility tensor for electron bubbles in ^{3}He-A from an exact quantum-mechanical solution of the anisotropic, elastic, ^{3}He quasiparticle - negative-ion scattering process. In particular, the authors determine the temperature-dependent magnitude of the energy gap in the superfluid A phase, (Delta sub A) (T), from ion-mobility data.

44453 **(PB—87-196267/XAB) Cosmic domain walls in superfluid ^{3}He-B: instantons in (k vector, r vector) - space.** Salomaa, M.M.; Volovik, G.E. (Helsinki Univ. of Technology, Espoo (Finland). Low Temperature Lab.). Apr 1987. 49p. (TKK-F-A—610). NTIS, PC PC E04/MF E01.

The possible planar superfluid B - B boundaries between inequivalent B-phase vacua are considered; such B - B interfaces provide an analogy with the cosmic domain walls that are believed to have precipitated in the phase transitions of the early Universe. The cosmic domain walls in superfluid ^{3}He-B are observable in principle; in particular, the motion of the superfluid A - B interface is governed at low temperatures by the periodical emission of these topological excitation planes. The edges of B - B interfaces serve to generate fractionally quantized pure and mixed mass, and spin-supercurrent vortices in ^{3}He-B, while holes in these surfaces give rise to the corresponding vortex rings and combined vortex and/or spin-disclination rings.

44454 **(PB—87-196275/XAB) Phase transition of the moving superfluid ^{3}He A - B interface.** Salomaa, M.M. (Helsinki Univ. of Technology, Espoo (Finland). Low Temperature Lab.). Feb 1987. 21p. (TKK-F-A—606). NTIS, PC PC E03/MF E01.

Recent Los Alamos data by Buchanan, Swift, and Wheatley on the propagation of the superfluid ^{3}He A - B phase front in hypercooled ^{3}He - A is suggested to manifest a novel phase transition. Symmetry analysis and numerical computations on the moving A - B boundary support such an interpretation and provide a tentative identification of the phase boundaries as functions of interface velocity.

6450 High Energy Physics

REFER ALSO TO CITATION(S) 44503, 44514

6451 Particle Interactions And Properties - Experimental

REFER ALSO TO CITATION(S) 43823, 43831, 44489, 44490, 44491

44455 **(BNL—39919) Search for neutrino oscillations.** Astier, P. (Brookhaven National Lab., Upton, NY (USA); Paris-6 Univ., 75 (France). Lab. de Physique Nucleaire et de Hautes Energies). 1987. Contract AC02-76CH00016. 15p. (CONF-870283—11). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012498.

From BNL neutrino workshop; Upton, NY, USA (5 Feb 1987).

The present paper reports on preliminary results from the E 816 experiment at Brookhaven National Laboratory. E 816 is the continuation of a 1984 experiment (PS 191) which was devoted to a neutrino decay search in the CERN PS neutrino beam. No candidate was seen, but a study of neutrino interactions in the calorimeter indicated an anomalous electron production. The statistics was too low and the experiment has been rerun in spring 86 at BNL to look specifically, with an improved detector for nu/sub e/ arising from a low energy nu/sub μ/ beam. The results presented here are preliminary for at least two reasons: first the collaboration is presently running a calibration test which results are not included here; second, only 1/3 of the neutrino data is used, and no mention will be made to antineutrino data for which the analysis is still going on. This report will directly start with a description of our apparatus, followed by the data analysis.

44456 **(CONF-870279—10) A search for (anti nu/sub μ/ ,anti nu/sub e/) oscillations at LAMPF [Los Alamos Meson Physics Facility].** Napolitano, J. (Argonne National Lab., IL (USA)). Feb 1987. Contract W-31109-ENG-38. 11p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87011488.

From Lake Louise winter institute; Alberta, Canada (15 Feb 1987).

Reasons for searching for neutrino oscillations are discussed briefly. An experiment in progress at the LAMPF beam stop is discussed which aims to be sensitive to the appearance of anti nu/sub e/ from anti nu/sub μ/ at a level of approximately 10^{-3}. Progress, status and upcoming plans for this experiment are also discussed.

44457 **(DOE/ER/03065—52) High energy physics: Progress report for December 1, 1986 to November 30, 1987.** Walker, W.D. (Duke Univ., Durham, NC (USA). High Energy Physics Group). Aug 1987. Contract AS05-76ER03065. 57p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87013950.

A brief but complete overview of current research activities in High Energy Physics at Duke University is given in this paper. Such activities include: hadroproduction of charm, beauty, baryons, and mesons, photoproduction of mesons, hadron nucleus collisions and search for quark-gluon plasma in anti pp collisions. (LSP)

44458 **(DOE/ER/03539—43) Experimental investigations in particle physics at intermediate energies: Progress report, December 1, 1986 to November 30, 1987.** Auerbach, L.B.; Highland, V.L.; McFarlane, K.W. (Temple Univ., Philadelphia, PA (USA). Dept. of Physics). Jun 1987. Contract AC02-76ER03539. 24p. (COO—3539-43). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013921.

The neutrino experiment at LAMPF (No. 764) has been completed with reports in preparation; the nu/sub μ/C scattering cross section agreed with the Fermi Gas model, and no evidence was seen for nu/sub μ/ $\rightarrow$ nu/sub e/ oscillations. The LAMPF Crystal Box work is almost complete, with publications on rare pion and muon decays. New limits have been set for a wide variety of decay modes: $\pi^0 \rightarrow 3\gamma < 3.1 \times 10^{-8}$, $\pi^0 \rightarrow 4\gamma < 2 \times 10^{-8}$, $\mu^+ \rightarrow e^+\gamma\gamma < 7.2 \times 10^{-11}$, $\mu^+ \rightarrow e^+\gamma$ familon $< 1.3 \times 10^{-8}$. In addition, the sign of the ratio of axial vector to vector in $\pi^+ \rightarrow e^+$ nuγ was determined to be positive. A new computing facility based on UNIX has been in operation. The rare Kaon decay (lepton-nonconserving and CP-violating decays) experiment at Brookhaven received beam in February and May 1987; we expect to extract an upper limit of a few times 10^{-9} for the decay K/sub L/ $\rightarrow \mu e$ from this first run.

44459 **(FNAL/C—87/109-E) Small t physics at the Tevatron Collider.** Bertani, M.; Giacomalli, G.; Maleyran, R.; Manarin, A.; Amos, N.; DeSalvo, R.; Baker, W.; Ellsworth, R.; Dimitroyannis, D.; Block, M. (Fermi National Accelerator Lab., Batavia, IL (USA); Bologna Univ. (Italy); European Organization for Nuclear Research, Geneva (Switzerland); Cornell Univ., Ithaca, NY (USA); George Mason Univ., Fairfax, VA (USA); Maryland Univ., College Park (USA)). 11 May 1987. Contract AC02-76CH03000. 9p. (CONF-8705163—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013566.

From From colliders to supercolliders workshop; Madison, WI, USA (11 May 1987).

The first physics run of the superconducting Tevatron Collider at Fermilab ended this morning. A status report will be presented on the progress of the small angle elastic scattering and total cross section experiment, E710. The goals of this experiment are to

measure the total proton-antiproton cross section from $\sqrt{s}$ = 300 to 2000 GeV, the slope of the diffraction peak and rho, the ratio of the real to imaginary part of the forward scattering amplitude, at these energies. 1 ref., 8 figs.

44460 (KEK—85-14, pp 18-38) **Meson spectroscopy experiment in charge exchange process.** Inagaki, Takao; Ohmi, Kazuhito. (National Lab. for High Energy Physics, Oho, Ibaraki, Japan). Feb 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87780150. (CONF-8502154—).

From Meeting on hadron spectroscopy; Oho, Japan (5 Feb 1985).

A charged and gamma spectrometer has been constructed and successfully used for a meson spectroscopy experiment (E64/121) at KEK. Some preliminary results of a high statistics data are presented. The ratio of differential cross sections of π/sup -/p -> etan and eta' was found to deviate from a prediction of a simple quark model. In a π/sup +/π/sup -/ spectrum, we can see a structure around 750 MeV just below the rho-ω interference structure. From a partial wave analysis of π/sup +/π/sup -/π/sup 0/ and π/sup +/π/sup -/eta in the high mass region, the existences of A/sub 1/ (IJ = 11/sup ++/), H (IJ = 01/sup +-/) and D (IJ = 01/sup ++/) were confirmed. The evidence of two pseudoscalar states (IJ = 00/sup -+/) at 1280 MeV and 1420 MeV was obtained.

44461 (KEK—85-14, pp 39-54) **Three-channel K-matrix analysis of dibaryons in J/sup P/ = 2/sup +-/ and 3/sup -/ states.** Hiroshige, Noboru. (Osaka City Univ., Japan. Research Inst. for Atomic Energy). Feb 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87780150. (CONF-8502154—).

From Meeting on hadron spectroscopy; Oho, Japan (5 Feb 1985).

We have investigated the dibaryon resonances with the quamtum numbers J/sup P/ = 2/sup +/, 2/sup -/ and 3/sup -/ in terms of a three-channel K-matrix method using the pp-pp, pp-πd and πd-πd amplitudes obtained by the partial-wave analysis as the input data. We have found many good solutions in each case and all of the solutions have a nearby pole in the lower-half complex energy plane. The obtained resonance masses cluster in the region 2.15 - 2.16 GeV. A remarkable finding of our three-channel analysis is that the dibaryon resonances have very weak coupling to the pp channel. To get more difinite conclusion we need the pp-NΔ and πd-NΔ amplitude as well as a better πd-πd one.

44462 (KEK—85-14, pp 55-68) **Search for baryonium by exclusive measurement of γ rays and π/sup 0/ in anti pp annihilation at rest.** Kobayashi, Masaaki; Ishimoto, Shigeru; Chiba, Masami. (National Lab. for High Energy Physics, Oho, Ibaraki, Japan). Feb 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87780150. (CONF-8502154—).

From Meeting on hadron spectroscopy; Oho, Japan (5 Feb 1985).

An experiment is proposed where all γ rays coming from anti pp annihilation at rest are measured in a NaI barrel having an acceptance of 50%. Another 50% will be covered by γ veto counters. In the γ spectrum, a narrow state with a yield of 2 x 10/sup -4/ of all annihilation could show up as a 7σ peak with S/N — 1/15. This is an order of magnitude improvement over inclusive γ measurement. In the π deg spectrum, a narrow state with a yield of 2 x 10/sup -3/ could show up as a 6σ peak with S/N — 1/100.

44463 (KEK—85-14, pp 69-86) **Investigation of J/sup PC/ = 1/sup -+/ hybrid mesons in anti pp annihilation at rest.** Kobayashi, Masaaki; Yoshida, Hajime. (National Lab. for High Energy Physics, Oho, Ibaraki, Japan). Feb 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87780150. (CONF-8502154—).

From Meeting on hadron spectroscopy; Oho, Japan (5 Feb 1985).

Detection of a hybrid meson H (I/sup G/ = 1/sup -/) with exotic quantum numbers J/sup PC/ = 1/sup -+/ is feasible by measuring anti pp at rest -> Hπ with H -> etaπ or rhoπ. An experimental setup assumed is an extension of the E68 (anti PPC): gamma detector (half of it as veto) and MWPC's both covering almost the whole solid angle. If the yield of anti pp -> Hπ is as large as 2 x 10/sup -3/ of all annihilation, the hybrid meson may be detected as a peak in etaπ or rhoπ invariant mass spectra at statistical significance above several σ with a typical signal to noise ratio around 1/10.

44464 (KEK—85-14, pp 1-17) **Recent status of meson spectroscopy experiment. Especially on glueballs.** Tsuru, Tsuneaki. (National Lab. for High Energy Physics, Oho, Ibaraki, Japan). Feb 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87780150. (CONF-8502154—).

From Meeting on hadron spectroscopy; Oho, Japan (5 Feb 1985).

Recent meson spectroscopy experiments are reviewed centering on glueballs and it is insisted as follows. Something may lie near 750 MeV. Scalar glueball at 750 - 1000 MeV should be studied. The G(1590) is to be investigated. Multiquark states need to be studied to establish the scalar nonet. We have some tensor glueball candidates, θ, 3 g/sub T/'s and zeta, which are to be further examined. Pseudoscalar states include many interesting physics. Some puzzles were solved. However, many problems remain unsolved and new puzzles appeared. Whether the E and I are the same state or not, and whether the E/I is a glueball or not are the major interests at present. Systematical experimental and theoretical works are required. In an experimental field, radial excitations, especially a radial excitation of eta', should be confirmed. In general higher statistics data are necessary to perform a complete partial wave analysis. A 1/sup ++/ isoscalar member, a partner of D(1280), is missing and required to be confirmed as soon as possible. A confirmation of this state will serve to solve the E/I puzzle. The state will be probably an (s anti s) state. 1/sup +-/ H', a partner of H(1190), is required to be confirmed. Multiquark states are to be investigated. "Oddballs" are to be challenged. Recent experiments require high statistics data enough to perform a model-independent partial wave analysis. The (q anti q) - (gg) mixing and hybrids are to be further studied in experimental and theoretical fields. (Nogami, K.).

44465 **(KEK—85-14) Proceedings of the meeting on hadron spectroscopy.** Inagaki, Takao; Kobayashi, Masaaki; Tsuru, Tsuneaki (eds.). (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Feb 1986. vp. (CONF-8502154—). NTIS (US Sales Only), PC A05/MF A01. File Number DE87780150.

From Meeting on hadron spectroscopy; Oho, Japan (5 Feb 1985).

Individual papers in these proceedings are separately abstracted. (LEW)

44466 **(LAL—86-20) Search of glueballs in the J/PSI -> γPHIPHI decay.** Bisello, D.; Busetto, G.; Castro, A. (Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire). Jul 1986. 15p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87752200.

In a study of the radiative decay J/PSI -> γPHIPHI -> γK/sup +/K/sup -/K/sup +/K/sup -/, from the 8.6 million J/PSI produced in the DM2 experiment at DCI, we found a large production of events with PHIPHI mass below the eta/sub c/. The branching ratio, for m/sub PHIPHI/ < 2.9 GeV/c/sup 2/, is BR(J/PSI -> γPHIPHI) = (3.1+- 0.3+- 0.6) x 10/sup -4/. The angular analysis of the events with PHI PHI mass below 2.5 GeV/c/sup 2/ is consistent with a 2/sup ++/ assignment. An enhancement near 2.2 GeV/c/sup 2/ shows a preferred spin-parity J/sup P/ = 0/sup -/.

44467 **(LAL—86-32) Topological isolation of the deep inelastic QED Compton scattering.** (Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire). Sep 1986. 9p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87752201.

The NA14 photoproduction experiment, carried out at the CERN SPS, has measured the inclusive cross-section of events with a prompt photon at high PTAU in the final state. Here we present a study of the topology of the final state of these events. The topology differs from that observed for events with an identified π/sup 0/ in the same kinematical domain. Using these differ-

ences we have extracted the contribution from the Born term to the inclusive prompt photon cross-section. The result is in good agreement with theoretical predictions and supports the assignment of a fractional electric charge to the quarks.

44468 **(LBL—23688) A measurement of the magnetic dipole moment of the Δii(1232) from the bremsstrahlung process $\pi p \rightarrow \pi p \gamma$.** Meyer, C.A. (Lawrence Berkeley Lab., CA (USA)). Jun 1987. Contract AC03-76SF00098. 142p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87014085.

We have measured the cross section from the bremsstrahlung process $\pi^+ p \rightarrow \pi^+ p\gamma$ for incident pions of energy 299 MeV. We detected the out going pion in the angular range from 55 to 95° in the lab, and photons were detected near 240° in the lab. We compare this measured cross-section to the MIT theory in order to extract a measurement of the magnetic dipole moment of the $\Delta^{++}(1232)$, μ/sub Δ/. In order to compare our results with the MIT theory, we have folded the MIT theory into the acceptance of our apparatus. We find that for pion angles between 55 and 75° the theory gives us a dipole moment of: 2.3μ/sub p/ < μ/sub Δ/ < 3.3μ/sup p/ where the quoted error arises from an experimental uncertainty of +-0.25μ/sub p/ and from theoretical uncertainties of +-0.25 μ/sub p/. However, for pion angles between 75 and 95° we find that the MIT theory predicts a cross-section which is larger than our measured cross-section, and makes it difficult to extract a value of μ/sub Δ/. This over prediction is not understood, but consistent with a similar effect when the MIT theory is fit to previous data. 78 figs., 29 tabs.

44469 **Evidence for the decay tau$^+$ -> π^+etaanti ν/sub tau/.** Derrick, M.; Kooijman, P.; Loos, J.S.; Musgrave, B.; Price, L.E.; Repond, J.; Sugano, K.; Blockus, D.; Brabson, B.; Brom, J.M. (Argonne National Lab., IL). *Physics Letters [Section] B;* **189**: No. 1/2, 260-266(30 Apr 1987). Contract W-31-109-ENG-38;AC02-76ER01112;AC03-76SF00098;AC02-76ER01428;AC02-84ER40125.

The inclusive production of eta mesons in tau lepton decay has been studied using the High Resolution Spectrometer at the PEP e^+e^- facility. The data sample corresponds to an integrated luminosity of 300 pb^{-1} an the storage ring was operated at $\sqrt{s}$=29 GeV. The eta production appears to be only compatible with the decay tau$^+$ -> π^+etaanti ν, which violates isospin and G-parity conservation. The branching ratio of 5.1+-1.5% explains much of the current discrepancy between the one-prong topological branching ratio and the sum of the individual one-prong modes.

44470 **The SSC and speculations on the future of proton machines.** Tigner, M. (SSC Central Design Group, c/o Lawrence Berkeley Lab., Berkeley, CA 94720). pp 1521-1522 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

In the U.S. a high energy physics community exists, in concert with many expert coleagues abroad, have submitted to the U.S. DOE, extensive documentation about the conceptual design, status of the R and D, and cost estimates for the SSC. Those documents come to more well over 2,000 pages and are available to anyone who would like to read them. This group is reviewed extensively by the DOE and all the expert committees that can possibly be put together and they have all concurred that the SSC is technically feasible, that the hardware is essentially in hand, and the cost has been properly calculated. That having been completed, the community withdraws into the inner sanctum to take counsel amongst themselves and decide whether or not to put the findings in the FY1988 budget. The next signal is when the President submits his budget in late January of 1988.

44471 **Ultra high energy physics with the Fly's Eye.** Baltrusaitis, R.M.; Cassiday, G.L.; Cooper, R.; Dawson, B.R.; Elbert, J.W.; Fick, B.E.; Liebing, D.F.; Loh, E.C.; Sokolsky, P.; Steck, D. (Dept. of Physics, Univ. of Utah, Salt Lake City, UT 84112). pp 1312-1316 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

The authors describe the operation of the Fly's Eye cosmic ray observatory. This detector observes ≅ 10/sup -17/ eV cosmic ray extensive air showers via air fluorescence. Results on the cosmic ray spectrum, anisotropy, composition and the ultra high energy neutrino flux, as well as a measurement of the σ/sub rho/ sup inel/-air/ cross section at $\sqrt{s}$ = 30 TeV are presented. Plans for expansion to include surface and underground arrays as well as improvements in resolution are described.

44472 **The heavy ion program at CERN.** Lissauer, D. (Brookhaven National Lab., Upton, NY 11973). pp 1415-1420 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—). Contract AC02-76CH00016.

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

During two periods in 1986 and 1987, oxygen ion beams with energies up to 3.2 TeV will be available at the CERN-SPS. A brief review of the five large heavy ion experiments is presented and the different physics addressed by each of the experiments is discussed.

44473 **Status of the RHIC project.** Ludlam, T. (Brookhaven National Lab., Upton, NY). pp 1421-1423 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

The Relativistic Heavy Ion Collider (RHIC) facility provides collision energies of 100 GeV/nucleon per beam for heavy ions as massive as gold. RHIC uses the existing Brookhaven AGS and Tandem Van de Graaff as injector. The new accelerator facility, which is a nuclear physics initiative, utilizes the existing facilities of the partially completed CBA project. This report discusses the status of the machine design, R&D work and preparations for experiments at RHIC.

44474 **BNL accelerator plans.** Lowenstein, D.I. (Brookhaven National Lab., Upton, NY 11973). pp 1509-1513 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

The Brookhaven National Laboratory plan for high energy and heavy ion physics accelerator use for the next ten-year period is described. The two major initiatives are in the construction of the Relativistic Heavy Ion Collider and the upgrade of the Alternating Gradient Synchrotron to a "Mini Kaon Factory".

44475 **Panel discussion on laboratory accelerator programs - present and future.** Richter, B. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA 94305). pp 1517-1520 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—). Contract AC03-76SF00515.

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

In this paper the author briefly summarizes the present SLAC accelerator program and then talks about the future of electron-positron linear colliders.

44476 **The reactions $\gamma\gamma \rightarrow$ K/sup 0/K/sup +-/π/sup -+/ and $\gamma\gamma^* \rightarrow$ K/sup 0/K/sup +-/π/sup -+t/.** Gidal, G.; Boyer, J.; Butler, F.; Cords, D.; Abrams, G.S.; Amidei, D.; Baden, A.R.; Barklow, T.; Boyarski, A.M.; Burchat, P. (Lawrence Berkeley Lab. and Dept. of Physics, Univ. of California, Berkeley, CA 94720). pp 1220-1222 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

A narrow state at 1425 MeV is observed in the K^{0}K/sup +-/π/sup -+/ final state produced in $\gamma\gamma$/sup */ interactions.

44477 **Production of single photons in hadron collisions.** Linnemann, J.T. (Michigan State Univ., East Lansing, MI 48824). pp 1122-1126 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

Recent single photon experiments are reviewed. New data on production cross sections are available, and compare satisfactorily with theoretical expectations.

44478 **Resonance formation in photon-photon collisions: Recent results from the TPC/two-gamma collaboration.** Eisner, A.M. (Univ. of California, Intercampus Institute for Research at Particle Accelerators, Stanford, CA 94305). pp 1211-1214 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

Results are presented from a search for narrow C = +1 resonances in virtual $\gamma\gamma$ collisions, using a missing mass technique. Upper limits (95% confidence level) range from 50 keV at a mass of 4.5 GeV, to 10 MeV at 19 GeV. Results are also presented on $\gamma\gamma$ production of K/sup +-/K^0/sub S/π/sup -+/ for masses near 1.45 GeV. For two quasi-real photons, no resonance is seen, and a 95% confidence level upper limit of 1.6 keV is found, lending support to the interpretation of the iota as a glueball candidate. When one photon is quite virtual, a resonance is seen at 1.42 GeV. The dependence of its production upon photon mass provides evidence that this is a spin-one state.

44479 **Search for two-prong proton decays at IMB.** Blewitt, G.; Bionta, R.M.; Bratton, C.B.; Casper, D.; Chrysicopolou, P.; Claus, R.; Cortez, B.G.; Dye, S.; Errede, S.; Foster, G.W. (264-737 Jet Propulsion Lab., Caltech, 4800 Oak Grove Drive, Pasadena, CA 91109). pp 1290-1292 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

A search for two-prong nucleon decays is undertaken using a data sample representing 417 of events observed by the IMB detector. An automated procedure is used to identify two-prong events, and to reconstruct invariant mass and momentum under various nucleon decay hypothesis. Two-prong event rates and characteristics are found to be consistent with the expected atmospheric neutrino background. Partial lifetime limits at the 90% C.L. are presented for specific decay modes. An SU(5) model-dependent limit is placed on the total proton lifetime at 9 x 10/sup 31/ years, which is inconsistent with the theory.

44480 **Exclusive Ξ/sup -/ production in 15-28 GeV neutron-proton interactions.** Church, M.; Gottschalk, E.; Hylton, R.; Knapp, B.C.; Stern, B.; Sippach, W.; Wiencke, L.; Christian, D.; Gutierrez, G.; Holmes, S. (Columbia Univ. Nevis Labs.). pp 1365-1368 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

The authors describe a detector capable of fully measuring high multiplicity hadron-hadron interactions at high rates. We then present preliminary results from a study of exclusive Ξ/sup -/ production in 15-28 GeV neutron-proton interactions in experiment 766 at the Brookhaven AGS.

44481 **Jet fragmentation at PEP.** Kooijman, P. (Argonne National Lab., Argonne, IL 60439). pp 1173-1180 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

Data from three experiments at the SLAC e/sup +/e/sup -/ storage ring (PEP) on fragmentation of quark and gluon jets are presented. Results on particle production, particle flow, and multiplicities are given and comparisons with models and data from hadronic initial states are made.

44482 **Early results on charm photoproduction.** Dos Anjos, J.C.C.; Appel, J.A.; Bracker, S.B.; Browder, T.E.; Cremaldi, L.M.; Elliot, J.R.; Escobar, C.; Estabrooks, P.; Gibney, M.C.; Hartner, G.F. pp 1369-1372 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

The authors report results from a preliminary analysis of approximately 15 million reconstructed events (15% of the data) from E-691, a charm photo-production experiment conducted at the Fermilab Tagged Photon Laboratory in 1985. The signal/background is 750/600 for D/sup +-/s and 700/450 for D^{0}s. This study presents p/sub t/ distributions, antiparticle/particle ratios for D mesons and the ratio of σ . B. for Fs and Ds decaying into the same final state, phiπ.

44483 **Antiproton-proton searches for quark-gluon plasma at the Fermilab collider.** Hojvat, C. (Fermi National Accelerator Lab., Batavia, IL 60510). pp 1402-1406 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

The Fermilab Tevatron antiproton-proton collider operators are reported. A brief description of experiments with the capacity for detecting the formation of quark-gluon plasma is presented.

44484 **Comparison of qq-barg and qq-barγ events in e/sup +/e/sup -/ annihilation at PEP.** Hofmann, W. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA 94720). pp 1093-1095 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—). Contract AC03-76SF00098.

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

In comparing the particle flow in the event plane of three-jet (qq-barg) events and of radiative annihilation events (qq-barγ) for similar kinematic configurations, two PEP experiments find a significant decrease in particle density in the angular region opposite to

the gluon jet in qq-barg events, relative to the particle density in the region opposite to the photon in qq-bary events. The effect is predicted both by QCD and by phenomenological string models.

6452 Particle Interactions And Properties - Theoretical

REFER ALSO TO CITATION(S) 43831, 44456, 44479, 44484, 44494, 44576

44485 **(CRN-HE—85-03) Examples of static localized solutions of nonlinear equations in 3 + 1 dimensions. III Bound mode with an imaginary frequency.** Umezawa, M. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). 1985. 35p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87752229.

There often appears a fluctuation with an imaginary frequency in the theory of the extended object. For the first time, a method is proposed to solve such an imaginary frequency mode by making use of the Yang-Feldman equation. It is found that the presence of such a mode does not influence the energy of the extended object. The nonlinear equation, for which this imaginary frequency mode obeys, further contains infinitely many other solutions with a continuous range of imaginary frequencies. These solutions are acceptable mathematically but have to be rejected in quantum mechanics because they diverge at infinity. As examples, we will solve two of these solutions having small frequencies.

44486 **(LBL—23435) A scenario for estimating the charge on the electron in terms of Planck's constant and the speed of light.** (Lawrence Berkeley Lab., CA (USA)). May 1987. Contract AC03-76SF00098. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013966.

The conjecture that the electron might be a soliton of a nonlinearly generalized, charge-free electromagnetic field, together with an estimate of the strength of the hypothetical non-linearity (based on the standard QED calculation of the scattering of light by light) leads to an estimate of the soliton's charge, -e, such that hC/e^2 turns out to be equal to 45π multiplied by a number of order one, whose precise value depends on the details of the soliton's radial form factor. 6 refs.

44487 **NN->NNπ at intermediate energies: predictions of a unitary model.** Dubach, J.; Kloet, W.M.; Silbar, R.R. (Massachusetts Univ., Amherst; Rutgers - the State Univ., New Brunswick, NJ; Los Alamos National Lab., NM). *Nuclear Physics [Section] A;* **466**: No. 3/4, 573-611(May 1987).

We explore the NN->NNπ reaction in detail within the context of a unified model which satisfies two- and three-body unitary. Predictions for differential cross sections and spin observables are examined and compared with experimental data, where available, for a variety of exclusive [pp->p(n)π^+, pp->pp(π^0), and np->p(p)π^-] and inclusive [pp->p(X) and pp->n(x)] reactions. Based on predictions of the model, further experiments are suggested to shed additional light on the NN->NNπ process. Due to dynamical symmetries the np->p(p)π^- observables are strikingly different from the more familiar pp->p(n)π^+ observables, and we urge that this reaction be investigated experimentally. Experimental tests for the existence of dibaryons are also briefly discussed.

44488 **Spectroscopy of light and heavy quarks.** Cooper, S. (SLAC, Summer Inst. on Particle Physics, Stanford, CT). pp 67-102 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

The author details with graphs and charts, the light mesons. Heavy mesons are also included in this study. The paper includes detailed discussions on glueballs, meson names and properties, mystery mesons, resonances, hadron collision, decays, MeV regions, radiative corrections and measurements and conclusions.

44489 **The physics of very high energy hadron-hadron colliders.** Hinchliffe, I. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA 94720). pp 1264-1275 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—). Contract AC03-76SF00098.

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

A review is given of the physics accessible at a very high energy hadron-hadron collider. Emphasis is placed on the reliability of the predicted rates, and upon the energy and luminosity required to explore new physics options.

44490 **Experimental review of the photon structure function.** Wagner, W. (Univ. of California, Davis, CA 95616). pp 1227-1231 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

The photon structure function F/sup γ//sub 2/ is considered an excellent tool to test QCD. Unlike baryons and mesons, the photon couples pointlike to quarks. This pointlike coupling gives rise to a contribution to the photon structure function, which is unique. It is absolutely calculable in perturbative QCD, and (unlike baryons and mesons) it rises with chi and Q/sup 2/. Furthermore, as a result of the quark propagator, it is sensitive to an energy scale, given by the quark mass in the QPM (F/sup γ//sub 2/ — iotan (W/sup 2//m/sup 2/)/sub q/) and by Λ in QCD (F/sup γ//sub 2/ — iotan (Q/sup 2//Λ/sup 2/)). The sensitivity to this scale is demonstrated by the TPC/2γ Collaboration, for the muonic photon structure function, which allows a 5% measurement of the muon mass. A measurement at only one fixed value of Q/sup 2/ allows a determination of Λ/sub M-barS-bar/ to a similar precision. The photon structure function contains an additional piece coming from the hadronic matrix element of the photon which is not calculable perturbatively. As for any other hadron, only the Q/sup 2/ dependence is predicted. One therefore has to make assumptions about this hadronic piece or try to measure it experimentally. Usually the hadronic component of the photon to the pion structure function is related, resulting in F/sup HAD//sub 2/= $0.2\alpha(1-x)$. An alternative approach is to study the Q/sup 2/ evolution only, which is safely predicted by QCD, but shows only little sensitivity to Λ.

44491 **Results from detailed calculations of atmospheric neutrino induced backgrounds in the IMB detector.** Haines, T.J.; Bionta, R.M.; Blewitt, G.; Bratton, C.B.; Casper, D.; Claus, R.; Cortez, B.G.; Errede, S.; Foster, G.W.; Gajewski, W. pp 1287-1289 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

The authors have made detailed modeling of atmospheric ν interactions in the IMB detector including essentially all possible final states. The results are compared with the 401 event observed during a 417 day exposure of the detector. These calculations give results that are consistent with the data and with each other. Background subtracted nucleon partial lifetime limits are given for 34 different decay modes. Limits range from of order 10/sup 31/ years to of order 10/sup 32/ years.

44492 **Spin effects in hadron interactions.** Crabb, D.G. (Randall Lab. of Physics, Univ. of Michigan, Ann Arbor, MI 48109). pp 1357-1360 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

The role of spin in five recent hadron experiments is discussed. Significant effects are seen in all the experiments.

44493 **Heavy quark production in quantum chromodynamics.** Brodsky, S.J. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA 94305). pp 1373-1380 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—). Contract AC03-76SF00515.

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

For very heavy quark masses, the inclusive hadronic production of hadron pairs containing heavy quarks is predicted to be governed by QCD fusion subprocesses. For intermediate mass scales other QCD mechanisms are important including higher-twist intrinsic contributions and low relative velocity enhancements, possibly accounting for the anomalies observed in charm hadroproduction, such as the nuclear number dependence, the longitudinal momentum distributions, and beam flavor dependence. This report also discusses scaling laws for exclusive processes involving heavy quarks and diffractive excitation into heavy quark systems.

6453 Particle Invariance Principles And Symmetries

44494 **(LAL—86-28) Searches for supersymmetry.** Grivaz, J.F. (Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire). Oct 1986. 9p. (CONF-860701—84). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752230.

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

Recent searches for supersymmetric particles, particularly in e/sup +/e/sup -/ interactions, are reviewed and compared. The mass domains experimentally excluded are turned into limits on the supersymmetry breaking parameters of a minimal N=1 supergravity model.

44495 **Supersymmetric Wess-Zumino action and U(1) gauge fields.** Clark, T.E.; Love, S.T. (Purdue Univ., Lafayette, IN; Stanford Linear Accelerator Center, CA). *Physics Letters [Section] B;* **189**: No. 4, 420-426(14 May 1987). Contract AC03-76SF00515;FG05-86ER40299.

The supersymmetric effective action is constructed which when varied under gauge groups containing explicit U(1) factors reproduces the mixed gauge field contribution to the SU(N) anomaly while being U(1) invariant. It constitutes a generalization of the supersymmetric Wess-Zumino action. The form of the supersymmetric mixed anomaly is also discussed.

6454 Field Theory

REFER ALSO TO CITATION(S) 44490, 44493

44496 **(RRK—87-2) Covariant Lorentz anomalies in higher dimensional space.** Yajima, Satoshi; Kimura, Toshiei. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Feb 1987. 35p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87753021.

The covariant Lorentz anomalies are evaluated by both the path integral and the topological methods, when Weyl fermions couple with the gauge and gravitational fields. In 2,4,6-dimensional curved space, the difference between the results obtained by the two methods is removed by counterterms and the equivalence of both methods is proved. It is shown that the Lorentz anomalies in flat space of arbitrary dimensions are eliminated.

44497 **(RRK—87-6) Chiral U(1) anomaly in D = 4 super Yang-Mills theory coupled to supergravity.** Nagahama, Yoshinori; Ojima, Syuichi; Sakai, Kenji; Takao, Masaru. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Mar 1987. 8p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87753022.

We evaluate the chiral U(1) anomaly in D = 4 supersymmetric Yang-Mills theory coupled to supergravity. We consider not only the minimal coupling between the gauge fields and fermions but also the interaction term which mixes gravitino and gaugino. We show that the mixing interaction gives the new contributions to the anomaly. This fact suggests necessity for reexamination of the Green-Schwarz anomaly cancellation mechanism.

44498 **(SLAC-PUB—4325) Blown-up orbifolds.** Cvetic, M. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). May 1987. Contract AC03-76SF00515. 10p. (CONF-8703143—3). NTIS, PC A02. File Number DE87013584.

From Workshop on superstrings, composite structures, and cosmology; College Park, MD, USA (11 Mar 1987).

A method to repair - "blow-up" - the singularities of the Abelian (2,2) orbifolds to obtain the corresponding (2,2) Calabi-Yau manifolds is presented. This approach makes use of the fact that with each orbifold singularity there are associated massless scalar fields - blowing-up modes - whose potential is flat to all orders in the string perturbation theory. The zero vacuum expectation values (VEV's) of the blowing-up modes correspond to the orbifold limit, while nonzero VEV's yield the corresponding Calabi-Yau manifold. One can then calculate explicitly, for such Calabi-Yau manifolds, the mass spectrum, Yukawa couplings, and all the other parameters of the effective Lagrangian by inserting successively all the background blowing-up modes with nonzero vacuum expectation value into the corresponding orbifold amplitudes. The results are exact at the string tree-level; however, they are perturbative in the blowing-up procedure. Mass spectra and Yukawa couplings for the blown-up Z_3 and Z_4 orbifolds are explicitly calculated. In particular all the E_6 singlets except the ones associated with the moduli-space of the blown-up orbifolds receive the mass; while the 27's and anti 27's do not pair up.

44499 **Derivation of Manin's formula.** Dugan, M.J. (California Univ., Berkeley; Lawrence Berkeley Lab., CA). *Physics Letters [Section] B;* **189**: No. 4, 417-419(14 May 1987). Contract AC03-76SF00098.

The formula of Manin for the bosonic string measure is derived using elementary methods.

65 PHYSICS II

REFER ALSO TO CITATION(S) 44228

6510 Nuclear Physics

REFER ALSO TO CITATION(S) 44561, 44774

44500 **(BNL-NCS—51771-Ed.1-Suppl.3) Integral charged particle nuclear data bibliography: Literature scanned from April 1, 1986 through April 10, 1987.** Holden, N.E.; Ramavataram, S.; Dunford, C.L. (National Nuclear Data Center, Upton, NY (USA)). Apr 1987. Contract AC02-76CH00016. 43p. NTIS, PC A03. File Number DE87013990.

This bibliography is divided into three sections, "References," "Target Index," and "Residual Index." The "References" section contains all references satisfying the following criteria: excitation functions, thick targets, or product yield leading to the formation of a ground or metastable state; the atomic mass and charge of the incident particle must be ≥ 1; the atomic mass of the target must be ≥ 1; and the atomic masses of the outgoing and residual nuclei must be ≥ 1 with the exception of processes which do not lead to a definite residual nucleus and of gamma-ray production cross sections. The "Target Index" section contains the incident particle energy and the abbreviated reference lines for all the entries, which contain information on a definite target nucleus and reaction. These reference lines contain the Journal name, followed by the volume and page number. The "Residual Index" section also contains the incident particle energy and the abbreviated reference lines for all the entries, which contain information on a definite residual nucleus and a definite target-reaction.

44501 **(DOE/ER/02171—228) Nuclear structure theory: Technical progress report for period September 1, 1986-August 31, 1987.** French, J.B.; Koltun, D.S. (Rochester Univ., NY (USA)). Aug 1987. Contract AC02-76ER02171. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013710.

This report summarizes progress in the following areas of research: (1) quark theory of nuclear matter, including further development of models in one-dimension with analytic solutions, numerical studies, bound properties, inclusion of spin and isospin degrees of freedom, excitation properties and response function; electron scattering, including application of sum rules to deeply inelastic scattering, and of quark models of nuclei; charge exchange in pion-nucleus reactions, including models of isotensor optical potential, optical theorem for double charge exchange, and coupled-channel calculations of single charge exchange; a unified theory of reaction dynamics and nuclear structure for intermediate energies, including diagrammatic formulation and development of appropriate computer programs; weak interactions: a study of the neutrino mass-matrix; bounds for time reversal noninvariance in the nucleon-nucleon interaction, obtained from spectral and strength fluctuations in complex nuclei, and separately from detailed balance in compound nuclear reactions. The relative sensitivities of the two methods are discussed; fluctuation measures for the two-dimensional harmonic oscillator; random matrices and symmetry-breaking in atomic spectra data; saturation effects for spectral measures in many-particle systems; and finally fluctuation-free statistical spectroscopy, applied to state densities and partition functions, including accurate absolute calculations of nuclear level spacings.

44502 **(DOE/ER/03496—82) Studies of heavy ion reactions and transuranic nuclei: Progress report for period September 1, 1986-August 31, 1987.** Huizenga, J.R.; Schroeder, W.U. (Rochester Univ., NY (USA). Dept. of Chemistry and Physics). Jul 1987. Contract AC02-76ER03496. 18p. (COO—3496-82). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013693.

The redistribution of mass, charge, and energy in heavy-ion reactions at energies up to 10 MeV per nucleon is investigated experimentally. Combined transport-evaporation calculations provide a frame of reference for the interpretation of complex data. Several apparent anomalies in the decay of compound nuclei at high excitation energies and spins are reconciled with the predictions of the statistical model. A new experimental method is applied to heavy-ion-induced fission. Aspects of novel experimental techniques employing neutron multiplicity meters in damped reactions are discussed, including the development of specialized electronics. Emphasis is placed on investigations of non-equilibrium, dynamical properties of the damped reaction mechanism. Quantitative model interpretations of fragment A and Z distributions illustrate the current lack of understanding of the balance between static and dynamic driving forces. Information on the time dependence of the dinuclear partition function is obtained from experiments measuring neutrons in coincidence with damped reaction fragments. The buildup and convective decay of dinuclear temperature gradients is explained in terms of a one-body transport mechanism. It is also concluded that a reduction in strength of the nuclear wall friction is not required in the interpretation of damped reaction data. An energy-loss dependence of preequilibrium neutron emission is demonstrated.

44503 **(DOE/ER/04043—47) Experiments on the nuclear interactions of pions: Progress report, December 1, 1986-November 30, 1987.** Minehart, R.; Ziock, K. (Virginia Univ., Charlottesville (USA)). Jul 1987. Contract AS05-76ER04043. 46p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013949.

The nuclear physics research program at the University of Virginia can be placed in four broad areas: studies on few-body nuclei at the Los Alamos Meson Physics Facility (LAMPF), medium energy particle physics, electro-nuclear physics, and absorption of anti-protons in heavy nuclei. The research being conducted at LAMPF includes total and differential cross sections for $\pi d \rightarrow pp$ below 20 MeV; pion scattering from helium isotopes; isospin dependence of pion absorption in ^{3}He, quasi-free pion single charge exchange on ^{3}He; performance testing of a BG0-NaI eta spectrometer; search for narrow resonances in the B = 2 missing mass spectrum from the ^{3}He(p,d)mm reaction; a study of quasi-free pion scattering in Li and C. Medium energy particle physics research includes a search for heavy neutrinos, precision measurement of the mass difference between the pion minus and pion neutral, and a search for the electroweak decay of the muon plus. Electro-nuclear research projects involve y-scaling in electron scattering from nuclei; electro-excitation of the delta particle in nuclei; transverse and longitudinal response functions for several nuclei near $Q^2 = 1$ (GeV/c)^2; two-body photodisintegration of the deuteron; the Q spared dependence of the ^{4}He(e,e'p) coincidence cross section at the quasielastic peak; and plans to sue the PEP for nuclear physics. A discussion of related activities and personnel is provided. 39 refs., 12 figs.

44504 **(DOE/ER/40251—2) Theoretical interpretation of data from high-energy nuclear collisions: Progress report for the period January 1, 1986-July 31, 1987.** Fai, G. (Kent State Univ., OH (USA)). Aug 1987. Contract FG02-86ER40251. 10p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87013943.

The main thrust of this research project have been the production of a sufficiently realistic and sufficiently fast event generator and is connected to the application of this background calculation to the analysis of data and to the design of new experiments in the field of high-energy heavy ion reactions. The microcanonical event generator which has been produced is named FREESCO (FRagmentation in an Explosion/Evaporation Simulation COde). Entropy values from data on central collisions have been extracted for Ca + Ca reactions at 400 MeV/neutron and 1050 MeV/nucleon and Nb + Nb reactions at 400 MeV/nucleon and 650 MeV/nucleon and for both reactions at beam energies on the order of 100 MeV. It was also found that the entropy can be determined approximately uniquely above 90 MeV/nucleon in the Ar + Ca system, independent of the assumed breakup temperature and density. One of the primary goals of colliding nuclei at high energies is to learn about the equation of state of nuclear matter. Research is continuing in this project on obtaining an equation of state at the temperatures and densities obtained in high-energy heavy ion collisions.

44505 **(DOE/OR/00033—T325) CIRRPC [Committee on Interagency Radiation Research and Policy Coordination] member agency participation in international radiation activities.** (Oak Ridge Associated Universities, Inc., TN (USA)). May 1987. Contract AC05-76OR00033. 47p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013668.

The member agencies of CIRRPC have considered what role the Committee might play in assuring that US participation in international organizations is consistent with US radiation policy and in encouraging cooperation in research and information exchange. The Executive Committee agreed that a first step in addressing such a potential involvement would be to compile certain basic information on the Federal government's present participation in international programs. Each of the CIRRPC member agencies has provided information on: (1) Points of contact within the agency having liaison with international organizations and having an interest in radiation matters; (2) staff attendance at international meetings on radiation matters; and (3) a listing of international organizations which routinely invite agency representatives to participate in such meetings. This report is composed of information obtained from the CIRRPC member agencies. We intend to update the report and expand it as necessary to meet future needs.

44506 **(IPNO-DRE—86-07) Heavy ion stopping at intermediate energies. Stopping powers of solids for /sup 16/O, / sup 86/Kr and /sup 129/Xe ions.** Bimbot, R.; Gauvin, H.; Orliange, I.; Anne, R.; Bastin, G.; Hubert, F. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1986. 21p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87752339.

The stopping power of 11 solid media have been measured for 50 and 94 MeV/u 0 ions, for 43 MeV/u Kr ions and for 24 MeV/u Xe ions from the French GANIL accelerator. The energy measurements were made using the LISE spectrometer. The accu-

racy in stopping power determinations is of +- 1-2 %. Charge state distributions of Kr and Xe ions exiting several targets have been determined. The stopping power data have been compared with semi-empirical values from the literature, and with a Z/sub 1//sup 2/ scaling relative to He ion stopping powers, Z/sub 1/ being the projectile atomic number. The oxygen data are in good agreement with the assumption of fully stripped ions inside the degrader. For 43 MeV/u Kr ions, an effective charge parameter equal to 0.95 has to be assumed for all targets. For 24 MeV/u Xe an effective charge parameter which depends on the degrader atomic number Z/sub 2/ must be used in order to explain the data.

44507 (JAERI-M—87-025, pp 1-8) **Review of JENDL-3 plan.** Asami, T. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Feb 1987. NTIS (US Sales Only), PC A16/MF A01. File Number DE87900676. (NEANDC(J)—123/U; INDC(JPN)—109/L; CONF-8611159—).

From Seminar on nuclear data; Tokai, Japan (26 Nov 1986).

Japanese Evaluated Nuclear Data Library, Version 3, JENDL-3 has planned to be used mainly for development of fusion reactors and studies of radiation shieldings as well as researches of fast breeder- and thermal reactors. Its compilation is now in progress, aiming at its completion in March 1987. The outline of JENDL-3 plan and the features of JENDL-3 data are presented together with its historical passages of JENDL-3 plan.

44508 (JAERI-M—87-025, pp 33-39) **For the enhancement of the utilization of nuclear data prepared by JNDC. Comments for the recommendation of the action for the post JENDL-3 project of JNDC.** Hasegawa, Akira. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Feb 1987. NTIS (US Sales Only), PC A16/MF A01. File Number DE87900676. (NEANDC(J)—123/U; INDC(JPN)—109/L; CONF-8611159—).

From Seminar on nuclear data; Tokai, Japan (26 Nov 1986).

The evaluated nuclear data, typically represented by JENDL-2, JENDL-3, has been prepared continuously by the number of enthusiastic evaluaters/supporters of Japanese Nuclear Data Committee (JNDC). But relatively low priority had been given to the effort for the promotion of the utilization of these data. Here I comment about how to enhance the utilization of the nuclear data prepared by JNDC. Stresses in the discussion are placed on the following Points; 1. preparation of common/standard group constants library, 2. development of JENDL value added data base, 3. Bulletine Board System for the feed back information data base of the experiences of JENDL, 4. Utilization of communication networks system, 5. nessecity of organization of users, of holdind a meeting/conference for the communication between users and evaluators.

44509 (JAERI-M—87-025, pp 70-90) **Nuclear data related to accelerator applications.** Mizumoto, Motoharu. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Feb 1987. NTIS (US Sales Only), PC A16/MF A01. File Number DE87900676. (NEANDC(J)—123/U; INDC(JPN)—109/L; CONF-8611159—).

From Seminar on nuclear data; Tokai, Japan (26 Nov 1986).

The use of particle accelerators for applied purposes becomes very common in recent year. The measurement and evaluation for nuclear data related to these applications are expected as one of the main activities after the evaluation works for the JENDL-3 file will be completed. In this report, some of the aims of accelerator applications will be discussed and the characteristics, in particular, of neutron data in the high energy region will be briefly described. As an example of such nuclear data needs, residual radio activities in the accelerator due to the operation of the JAERI Electron Linac will be presented.

44510 (JAERI-M—87-025, pp 121-154) **Group cross sections of fission products and minor actinides.** Takano, Hideki; Ihara, Hitoshi; Akie, Hiroshi. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Feb 1987. NTIS (US Sales Only), PC A16/MF A01. File Number DE87900676. (NEANDC(J)—123/U; INDC(JPN)—109/L; CONF-8611159—).

From Seminar on nuclear data; Tokai, Japan (26 Nov 1986).

Group cross section library for fission products and minor actinides has been generated with the TIMS-PGG processing code on the basis of the evaluated nuclear data file JENDL-2. For fast reactor calculations, the lumped group cross sections of fission products for mother nuclides U-235, U-238, Pu-239 and Pu-241 were generated by taking into account burnup dependence and fission gas release. This group constant library is called JFS-3-J2/FP2. For thermal reactor calculations, the fission product chain model in which the 65 nuclides are explicitly treated have been studied and the pseudo group cross sections with the 107 energy group structure were generated. The group constant library generated is called SRACLIB-JENDL-2. Resonance self-shielding effect of fission products on burnup reactivity loss has been investigated by using the SRACLIB-JENDL-2 library in high conversion light water reactors. The effect of nuclear data uncertainties of fission products and minor actinides on the burnup reactivity change has been examined by comparing the results obtained with four evaluated nuclear data files; JENDL-2, JEF-1, ENDF/B-IV and -V. The effect of the minor actinides such as Am and Cm on burnup reactivity loss has been also examined by performing the burnup calculation for the HCLWR lattice.

44511 (JAERI-M—87-025, pp 217-229) **Usage of nuclear data library and proposal to JENDL.** Sasaki, M.; Iijima, S.; Kawai, Y.; Matsunobu, H.; Zukeran, A. (Mitsubishi Atomic Power Industries, Inc., Tokyo, Japan). Feb 1987. NTIS (US Sales Only), PC A16/MF A01. File Number DE87900676. (NEANDC(J)—123/U; INDC(JPN)—109/L; CONF-8611159—).

From Seminar on nuclear data; Tokai, Japan (26 Nov 1986).

A usage status of nuclear data libraries and proposals to the JENDL library are briefly reviewed. 1) Data bases used in plant design and fuel cycle design fields are summarized. JNDC evaluated data and JENDL are not utilized so much than expected in these fields. 2) Performances between JENDL-2 and ENDF/B-IV are compared in the FBR nuclear design field. JENDL-2 shows good characteristics. 3) Usages of JENDL-2 are shown in the LWR nuclear design field. JENDL-2 isn't always superior to the licensing library. 4) Usages of JENDL-2 are shown in the FBR shielding R D field. JENDL-2 underestimates measured spectra in case of the deep penetration experiment. 5) Based on the above usage status of JENDL-2, proposals to future JENDL and Nuclear Data Center are tabulated.

44512 (JAERI-M—87-025, pp 244-261) **Program of activation cross section measurements on fusion reactor structural components for 14 MeV neutrons using FNS facility.** Ikeda, Y.; Konno, C.; Nakamura, T.; Oishi, K.; Kawade, K.; Yamamoto, H.; Miyade, H.; Yamada, T.; Katoh, T. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Feb 1987. NTIS (US Sales Only), PC A16/MF A01. File Number DE87900676. (NEANDC(J)—123/U; INDC(JPN)—109/L; CONF-8611159—).

From Seminar on nuclear data; Tokai, Japan (26 Nov 1986).

More than one hundred neutron activation cross sections on the fusion reactor structural components have been measured for the energy range from 13.3 to 14.9 MeV utilizing the FNS facility in order to meet the nuclear data needs in the fusion applications. To achieve the high quality experimental data in terms of accuracy, reproducibility and reliability, considerable cares have been taken into the data taking and their process by introducing the sophisticated measuring technique to reduce significantly the overall experimental time. The data measured showed much improvement in the accuracy in comparison with previous data. The new compilation based on the present data will be helpful for the new evaluation of the activation and the dosimetry files.

44513 (JAERI-M—87-025, pp 331-336) **Multistep statistical-model code TNG.** Shibata, K. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Feb 1987. NTIS (US Sales Only), PC A16/MF A01. File Number DE87900676. (NEANDC(J)—123/U; INDC(JPN)—109/L; CONF-8611159—).

From Seminar on nuclear data; Tokai, Japan (26 Nov 1986).

Features of the TNG code are presented. Furthermore, recent improvements of the code are also discussed.

44514 **(LA—10956-C) Proceedings of the twentieth LAMPF users group meeting.** Marinuzzi, R. (comp.). (Los Alamos National Lab., NM (USA)). Apr 1987. Contract W-7405-ENG-36. 259p. (CONF-8610183—). NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE87012707.

From 20. LAMPF Users Group meeting; Los Alamos, NM, USA (27 Oct 1986).

The Twentieth Annual LAMPF Users Group Meeting was held October 27-28, 1986, at the Clinton P. Anderson Meson Physics Facility. The program included a number of invited talks on various aspects of nuclear and particle physics as well as status reports on LAMPF and discussions of upgrade options. The LAMPF working groups met and discussed plans for the secondary beam lines, experimental programs, and computing facilities. Individual papers have been cataloged separately.

6511 Experimental Techniques

REFER ALSO TO CITATION(S) 43916

44515 **(IPNO-TH—86-57) Heavy ion scattering: An analysis of the angular distributions through the "envelope method".** Da Silveira, R.; Leclercq-Willain, C. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). Jul 1986. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87752341.

This talk discusses the physical origin of the different scattering components, the interference of which originate the oscillatory patterns observed in nuclear scattering. The analysis uses a very simple model-independent method. This is based on elementary wave-mechanical arguments and therefore applies to all interfering phenomena giving rise to well defined oscillatory patterns. Finally, an application of the same method to a classical inversion procedure is briefly presented. 12 refs.

44516 **Future directions and emerging techniques for ISOL systems.** Talbert, W.L. Jr.; Bunker, M.E. (Los Alamos National Lab., Los Alamos, NM 87545). pp 645-657 of Nuclear structure, reactions and symmetries. Meyer, R.A.; Paar, V. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-8606130—).

From International conference on nuclear structure, reactions, and symmetries; Dubrovnik, Yugoslavia (5 Jun 1986).

Isotope separator on-line (ISOL) systems have been in use for over 20 years and have made an enormous contribution to our knowledge of nuclei. However, these past efforts have acquired only a modest fraction of the potential nuclear data of value in fundamental and applied nuclear science. It now appears, through the use of new ISOL techniques that have been developed or are being developed, that the frontiers of knowledge about nuclei far from stability can be extended considerably. The authors discuss the current status and future promise of ISOL systems, with emphasis on newly conceived experimental capabilities and interests. In addition to studies of nuclear structure using traditional or new on-line approaches, such as on-line nuclear orientation, we point out the possibilities for studies with accelerated radioactive beams that have direct application to basic problems in materials science and astrophysics as well as to nuclear theory.

44517 **Use of the (t,p) reaction for in-beam spectroscopy studies.** Henry, E.A. (Lawrence Livermore National Lab., Livermore, CA 94550). pp 616-623 of Nuclear structure, reactions and symmetries. Meyer, R.A.; Paar, V. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-8606130—). Contract W-7405-ENG-48.

From International conference on nuclear structure, reactions, and symmetries; Dubrovnik, Yugoslavia (5 Jun 1986).

Triton induced reactions, such as the (t,p) reaction, can be used for in-beam gamma-ray and conversion-electron studies of nuclei that are somewhat neutron rich. The author has developed systems for both conversion-electron and gamma-ray spectroscopy in coincidence with the outgoing energetic proton to identify the (t,p) reaction channel. Data from the /sup 142/Nd(t,p gamma) reaction illustrate several of the characteristics of this reaction for studying nuclear structure. Preliminary results from the study of /sup 96/Zr by conversion-electron spectroscopy, and /sup 240/U by gamma-ray spectroscopy, are reported.

6512 Nuclear Properties And Reactions, A=1-5, Experimental

44518 **Elastic scattering of πi and π^- mesons from ^{3}He and ^{4}He at energies from 300 to 475 MeV.** Boswell, J.; Das, G.S.; Gugelot, P.C.; Kallne, J.; McCarthy, J.; Orphanos, L.; Minehart, R.C.; Withney, R.R.; Gram, P.A.M. (Virginia Univ., Charlottesville; Los Alamos National Lab., NM). *Nuclear Physics [Section] A;* **466**: No. 3/4, 458-472(May 1987).

The cross section for elastic scattering of pions from ^{3}He and ^{4}He was measured for incident energies from 300 to 475 MeV. The pions were detected in a magnetic spectrometer at scattering angles from 30^0 to 130^0. Results on angular distributions are presented. A particularly interesting feature is that a deep minimum at 110^0, previously observed at 295 MeV, is found to persist up to 400 MeV. The minimum is fixed in angle and is therefore not a simple function of q^2.

44519 **Deuteron forward photodisintegration meson currents and relativity.** Friar, J.L. (Los Alamos National Lab., Los Alamos, NM). pp 124-138 of Perspectives in nuclear physics at intermediate energies. Boffi, S.; Ciofi degli Atti, C.; Giannini, M.M. Teaneck, NJ; World Scientific Pub. Co. (1984). (CONF-8310207—).

From Workshop on perspectives in nuclear physics at intermediate energies; Trieste, Italy (10 Oct 1983).

The few-nucleon problem in nuclear physics and the few-electron problem in atomic physics are shown to possess similarities. Relativistic aspects of the latter are reviewed. The radiative decay of the /sup 3/P/sub 1/ excited state of helium-like ions to the /sup 1/S/sub 0/ ground state is shown to be a theoretical analogue of low-energy deuteron forward photodisintegration. Both have large relativistic components. The extended Siegert's theorem, which permits application of Siegert's technique to arbitrary photon wave lengths, is applied to both transitions. Physical arguments for the two processes are stressed, and the relevance of interaction currents is discussed.

6513 Nuclear Properties And Reactions, A=6-19, Experimental

44520 (ANL-PHY—86-1, pp 519-524) **Entrance channel limitations in the high energy fusion of light-heavy systems leading to ^{40}Ca and ^{42}Ca.** Harmon, B.A.; Shapira, D.; Stelson, P.H.; Burks, B.L.; Erb, K.A.; Shivakumar, B.; Teh, K.; Thornton, S.T. (Univ. of Virginia, Charlottesville). 1986. NTIS, PC A99/MF A01. File Number DE87010055. (CONF-860396—). Contract AC05-84OR21400.

From Symposium on the many facets of heavy ion fusion reactions; Argonne, IL, USA (24 Mar 1986).

The fusion cross section of light-heavy ions drops below the total reaction cross section with increasing energy and then decreases rapidly when the bombarding energy is further increased. This decrease in the fusion cross section (σ/sub fus/) at high energy can be understood in terms of a limit on the angular momentum the fusing system is able to support. It is not clear however what this limit is due to. It may be due to the paucity of high spin states in the compound nucleus, or to its inability to sustain the high angular momentum brought in by the entrance channel. A limitation to σ/sub fus/ can be also brought about at high angular momentum when the repulsive forces of the combined Coulomb and centrifugal potentials overcome the attractive nuclear forces and prevent the fusion of the colliding nuclei. The question of compound nucleus or entrance channel-type limitation to the fusion cross section has been approached effectively in experiments where the same compound nucleus is populated by different projectile-target combinations. Fusion data are available for several systems leading to the compound nuclei ^{40}Ca and ^{42}Ca. In this study we

report on measurements of fusion cross sections done on $^{28}Si + ^{12}C$ and $^{30}Si + ^{12}C$ over a wide range of bombarding energies. These data are combined with available data to show the presence of a strong entrance channel limit for fusion in these two systems.

44521 (ANL-PHY—86-1, pp 605-612) **Destination fusion.** Shivakumar, B.; Shapira, D.; Stelson, P.H.; Beckerman, M.; Harmon, B.A.; Teh, K.; Ayik, S. (Yale Univ., New Haven, CT). 1986. NTIS, PC A99/MF A01. File Number DE87010055. (CONF-860396—). Contract AC05-84OR21400.

From Symposium on the many facets of heavy ion fusion reactions; Argonne, IL, USA (24 Mar 1986).

Direct fragmentation, or orbiting, of a dinuclear complex in heavy ion fusion reactions was studied in the system nitrogen 14 + silicon 28 at energies from 100-170 MeV at the Oak Ridge National Laboratory. Spectra and yields of reaction products were measured. Angle-integrated absolute orbiting cross sections for the main exit channels are plotted as functions of energy. The reaction shows all the signatures expected of the orbiting process.

44522 **(CRN-PN—86-10) Reaction /sup 12/C + /sup 12/C at bombarding energies from 5 to 10 MeV per nucleon.** Morsad, A. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). 1986. 146p. (In French). NTIS (US Sales Only), PC A07/MF A01. File Number DE87752202.

The reaction /sup 12/C + /sup 12/C has been studied for energies ranging from E/sub LA /B = 60 to 120 MeV. The excitation functions and angular distributions were obtained for the elastic (0/sup +/, 0/sup +/) and inelastic (2/sup +/, 0/sup +/), (2/sup +/, 2/sup +/) channels as well as for the transfer channels of one and two nucleons. For the transfer reactions, the feeding of the final bound states was very selective. Narrow correlated structures were found in the transfer and especially in the elastic and inelastic channels. In this energy range, there appears to be a transition from surface transparency to interference phenomena. The optical model in its simplest form is unable to describe the elastic scattering at large angles. This has been interpreted as a consequence of the coupling between the elastic and inelastic channels which is particularly strong of these energies. 80 refs.

44523 **(INIS-mf—10638) Analysis of Doppler broadened γ spectra of the (2.3 -> 0)MeV-γ-transition in /sup 14/N nuclei.** Zielinski, M. (Koeln Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet). 14 Jun 1986. 71p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE87752444.

With /sup 3/He particles of an energy of 6.23 MeV via the reaction /sup 12/C(/sup 3/He,p)/sup 14/N* fast nitrogen nuclei in the first two excited states at 2.3 MeV and 3.9 MeV were produced. The nuclei were stopped in nickel, copper, and silver targets. From the Doppler-broadened spectra of the (2.3 -> 0) MeV transition measured in coincidence with the protons first for the three materials each the product of the lifetime tau/sub 1/ and the differential energy loss as well as the ratio tau/sub 2//tau/sub 1/ could be determined. The comparison with existing energy-loss data for nickel and silver then yielded the values tau/sub 1/ = (97.7 +- 5.5) fs and tau/sub 2/ = (5.6 +- 1.1) fs as well as the differential energy loss of /sup 14/N projectiles in nickel, copper, and silver in the velocity range from 0.004 c to 0.022 c. As the systematic errors in Doppler shift experiments are generally relatively high in the analysis of the spectra it was precisely studied which secondary effects influence the shape of the spectra. The effects were quantitatively recorded, and it is shown how strongly they each alter the measurement results. The results for tau/sub 1/ and tau/sub 2/ are compared with those of other authors, and possible causes for the strong dispersion of the other measuring values are shown. The energy loss curves are discussed in connection with the Z/sub 2/ oscillations.

44524 (JAERI-M—87-025, pp 289-301) **Study on capture gamma-ray spectra in the keV-neutron region.** Kitazawa, H.; Igashira, M. (Tokyo Inst. of Tech., Japan. Research Lab. of Nuclear Reactor). Feb 1987. NTIS (US Sales Only), PC A16/MF A01. File Number DE87900676. (NEANDC(J)—123/U; INDC(JPN)—109/L; CONF-8611159—).

From Seminar on nuclear data; Tokai, Japan (26 Nov 1986).

Capture gamma-ray spectra of O-16, Si-28 and S-32 have been measured to investigate the mechanism of the neutron capture on s- and p-wave resonances with large reduced neutron width. For heavy nuclei with the neutron number N = 50 - 126, characteristic features of the pygmy E1 resonance were obtained to disclose the physical origin of the resonance. Moreover, resonance-averaged capture gamma-ray spectra of Fe-56 have been measured at the neutron energies of 20 - 600 keV, which will be utilized as photon-production data of the japanese evaluated nuclear data library JENDL-3.

44525 **Velocity and angular distributions of evaporation residues from /sup 32/S-induced reactions.** Hinnefeld, J.D.; Kolata, J.J.; Henderson, D.J.; Janssens, R.V.F.; Kovar, D.G.; Lesko, K.T.; Rosner, G.; Stephans, G.S.F.; van den Berg, A.M.; Wilkins, B.D. (Department of Physics, University of Notre Dame, Notre Dame, Indiana 46556). *Physical Review* [*Section*] *C: Nuclear Physics;* **36**: No. 3, 989-999(Sep 1987).

Velocity distributions of mass-resolved evaporation residues from reactions of /sup 32/S with /sup 12/C, /sup 24/Mg, /sup 27/Al, /sup 28/Si, and /sup 40/Ca have been measured at bombarding energies of 194, 239, and 278 MeV using time-of-flight techniques. In all cases, the observed shifts in the velocity centroids relative to the values expected for complete fusion are consistent with a previously reported parametrization of a threshold for onset of incomplete fusion. Angular distributions were measured and total cross sections extracted for the /sup 32/S+ /sup 24/Mg system at all three energies. A comparison with existing results for /sup 32/S+ /sup 24/Mg at lower energies, and with other systems leading to the /sup 56/Ni compound nucleus, suggests two different types of compound-nuclear limitations to complete fusion at higher energies.

44526 **Preliminary results from a precision measurement of the x,Q/sup 2/ and nuclear dependence of R = σ/sub L//σ/sub T/.** Dasu, S.; De Barbaro, P.; Walker, R.C.; Whitlow, L.W.; Alster, J.; Arnold, R.; Benton, D.; Bodek, A.; Bosted, P.; Button-Shafer, J. (Univ. of Rochester, Rochester, NY 14627). pp 1109-1112 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

The authors have measured R=σ/sub L//σ/sub T/ in deep inelastic electron scattering from hydrogen, deuterium, iron and gold targets in the kinematic region x = 0.20, 0.35 and 0.50 and 1 ≦ Q/sup 2/ ≦ 10(GeV/c)/sup 2/. Preliminary results are presented for deuterium and iron at x=0.5. For deuterium R decreases with increasing Q/sup 2/ from — 0.25 at Q/sup 2/ =2.5 down to — 0.1 at Q/sup 2/ = 10(GeV/c)/sup 2/ as is expected from a combination of perturbative QCD, finite quark mass corrections and finite quark transverse momentum. No difference between R/sub d/ and R/sub Fe/ is observed.

6514 Nuclear Properties And Reactions, A=20-38, Experimental

44527 **(DOE/ER/40314—1) Research in nuclear physics: Progress report, August 1, 1986-July 31, 1987.** Kozub, R.L. (Tennessee Technological Univ., Cookeville (USA). Dept. of Physics). Jul 1987. Contract FG05-87ER40314. 37p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013455.

Most activity centered around two successful experiments to study excited states in exotic neutron-rich nuclei using the new γ-ray facility at the Argonne Tandem-Linac Accelerator System (ATLAS). During the past year, the ATLAS data acquisition/analysis code DAPHNE has become transportable, and we have recently installed the code on our VAX 11/725 computer to give us the capability of more refined analyses of our ATLAS data. Our own code NUPHIAS has fewer features than DAPHNE, but will still be useful for efficient preliminary sorting of data from other laboratories.

44528 **(GANIL-P—86-19) Dissipative effects in projectile fragmentation.** Bonasera, A.; Di Toro, M.; Gregoire, C. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). 1986. 55p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87752353.

Reaction mechanisms in intermediate energy heavy ion collisions are studied. A two step model is proposed. Dissipative stage and abrasion stage are considered with special emphasis to phase space configuration of participant region. Fragmentation and damped collisions are found with their relative importance. Results are given for main observables and are compared to existing experimental data. Comparisons with other models are also discussed. (41 refs, 18 figs).

44529 **(GANIL-P—86-22) Peripheral reactions at intermediate energies in Landau-Vlasov dynamics.** Gregoire, C.; Vinet, L.; Remaud, B.; Sebille, F. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). 1986. 16p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87752355.

Peripheral reactions have been studied within a self consistent description of heavy ion induced reactions at intermediate energies. Neutrons and protons behave separately in an effective mean field and suffer two body collisions. Nuclear surface properties are obtained using a decomposition of the one body distribution function on a coherent states basis. Charge equilibration, spin deposition and projectile like energies are described for quasi-fragmentation reactions. The transition between incomplete deep inelastic processes and fragmentation reactions is found for an incident energy around 35 MeV per nucleon.

44530 **(GANIL-P—86-25) Lise facility and the production of exotic nuclei at intermediate energies.** Guillemaud-Mueller, D. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). 1986. 16p. (CONF-8609159—7). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752356.

From International school-seminar on heavy ion physics; Dubna, USSR (23 Sep 1986).

At intermediate energy, it has been shown that the process of projectile fragmentation remains predominant. In this paper, I want to demonstrate how it has allowed advance in the production of isotopes (Z $\leqq$ 29) far off stability on both sides. In the following I shall comment on the choice of reaction conditions, describe the recoil spectrometer LISE and report on experiments performed so far.

44531 **Delayed proton activities produced in /sup 24/Mg + Ca and /sup 28/Si + Ca reactions.** Hotchkis, M.A.C.; Moltz, D.M.; Reiff, J.E.; Blonnigen, F.; Lang, T.F.; Xu, X.; Cerny, J. (Dept. of Chemistry and Nuclear Science Div., Lawrence Berkeley Lab., Univ. of California, Berkeley, CA 94720). pp 775-782 of Nuclear structure, reactions and symmetries. Meyer, R.A.; Paar, V. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-8606130—). Contract AC03-76SF00098.

From International conference on nuclear structure, reactions, and symmetries; Dubrovnik, Yugoslavia (5 Jun 1986).

The authors have searched for new delayed-proton emitters in /sup 24/Mg and /sup 28/Si bombardments of Ca targets to extend our knowledge about the proton drip line in the A = 60-65 mass region. Definitive evidence for the A = 4n+1, T/sub z/ = -3/2 nuclide /sup 61/Ge is presented, but a search for the next member in this series, /sup 65/Se, proved fruitless.

6515 Nuclear Properties And Reactions, A=39-58, Experimental

44532 **(INIS-mf—10640) Spectroscopic studies of $\Delta T=1$ reactions with heavy ions.** Miczaika, A. (Freie Univ. Berlin (Germany, F.R.). Fachbereich Physik). 16 Oct 1985. 73p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE87752442.

With a Q3D magnet spectrometer the charge-exchange reactions /sup 58/Ni(/sup 13/C,/sup 13/N)/sup 58/Co at E/sub lab/ = 140, 190 MeV, /sup 58/Ni(/sup 15/N,/sup 15/O)/sup 58/Co at E/sub lab/ = 180 MeV respectively /sup 58/Ni(/sup 13/C,/sup 13/B)/sup 58/Cu at E/sub lab/ = 140 MeV and /sup 58/Ni(/sup 15/N,/sup 15/C)/sup 58/Cu at E/sub lab/ = 180 MeV were measured. The (/sup 13/C,/sup 13/N) reaction at E/sub lab/ = 140 MeV was analyzed as two-stage process with the intermediate stages /sup 58/Ni(/sup 13/C,/sup 14/N)/sup 57/Co respectively /sup 58/Ni(/sup 13/C,/sup 12/C)/sup 59/Ni. The angular distributions show at forward angles a characteristic dependence of the shape on the transferred angular momentum. Therefore also a 0/sup 0/ measurement for the reaction channels /sup 13/N and /sup 14/N was performed. Detailed DWBA calculations of the one- and two-stage processes to the low-lying excited states in /sup 57/Co, /sup 59/Ni, and /sup 58/Co could well reproduce the experimental data in the shape. The absolute heights of the cross sections are for the p transfer also correctly reproduced. However, for the n transfer they are by a factor 3 too large and for the /sup 13/N channel at application of maximal amplitudes by a factor 6 too small. This lies however in the usual range of theoretical calculations to two-nucleon transfer reactions. At higher excitation energies in the charge-exchange spectra a pronounced continuum is observed. A possible many-body concurrence process (pick-up and decay of the projectile) could be farly excluded by comparison of the measured shape with theoretical calculations respectively by coincidence experiments, so that this region is mainly determined by the excitation of close-lying higher levels. The dependence of the cross section on the excitation energy E/sup */ and the angular momentum l of the final state is discussed.

44533 (JAERI-M—87-025, pp 273-288) **Measurements of fast neutron inelastic-scattering and fission cross sections.** Itagaki, S.; Baba, M.; Iwasaki, T.; Hirakawa, N.; Sugiyama, K. (Tohoku Univ., Sendai, Japan. Dept. of Nuclear Engineering). Feb 1987. NTIS (US Sales Only), PC A16/MF A01. File Number DE87900676. (NEANDC(J)—123/U; INDC(JPN)—109/L; CONF-8611159—).

From Seminar on nuclear data; Tokai, Japan (26 Nov 1986).

Recent experiments performed at Tohoku University 4.5-MV Dynamitron accelerator are described briefly: (1) measurements of double-differential neutron emission cross sections of Ti, Fe, Ni, Cu and Zr, (2) measurements of inelastic scattering cross sections determined from Cr(n,n'γ) reaction, and (3) measurements of fission cross section ratio of actinide nuclei, and absolute value of /sup 235/U. The results obtained are compared with experimental results of others and evaluated data in JENDL-2, -3PR and ENDF/B-IV.

44534 **(LBL—23476) Multifragmentation and flow in central collisions of heavy systems.** Harris, J.W.; Jacak, B.V.; Kampert, K.H.; Claesson, G.; Doss, K.G.R.; Ferguson, R.; Gavron, A.I.; Gustafsson, H.A.; Gutbrod, H.; Kolb, B. (Lawrence Berkeley Lab., CA (USA); Los Alamos National Lab., NM (USA); Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Oak Ridge National Lab., TN (USA)). May 1987. Contract AC03-76SF00098. 14p. (CONF-870410—35). NTIS, PC A02/MF A01; GPO Dep. File Number DE87011377.

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

Experimental results are presented on the production of light particles (A < 5) and intermediate mass fragments (6 < A < 18) over a large solid angle. The reactions 200 MeV/n Au + Au amd Au + Fe were studied to provide information on multifragmentation processes and collective flow. 20 refs., 6 figs.

44535 **A self-calibrated neutron capture measurement of the 1.15-keV resonance of iron.** Macklin, R.L. (Oak Ridge National Lab., P.O. Box X, Building 6010, Oak Ridge, TN 37831). *Nuclear Science and Engineering;* **95**: No. 3, 200-205(Mar 1987). Contract AC05-84OR21400.

A measurement with thick and thin iron samples showed that Γ/sub n/Γ/sub γ//Γ = 55.5 +- 0.6 meV and Γ/sub n/ = 61.5 +- 0.7 meV for the 1.15-keV iron resonance. Since iron is a major constituent in many nuclear fission and fusion reactor structural parts, determining the neutron capture cross section for iron has been especially important to reactor design.

6516 Nuclear Properties And Reactions, A=59-89, Experimental

44536 **(CRN-PN—86-08) From quasi-elastic to compound nucleus-like processes induced by 140 MeV /sup 19/F beam on /sup 89/Y target.** Mermaz, M.C.; Suomijarvi, T.; Lucas, R. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). 1986. 32p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87752203.

Various exit channels ranging from /sup 6/Li to /sup 27/Al for the /sup 89/Y(/sup 19/F,x)y reaction have been studied at 140 MeV incident energy. Energy spectra and angular distributions were measured between 10 deg and 160 deg laboratory angles. Three different reaction mechanisms were observed: quasi-elastic collisions, deep-inelastic collisions and, with weaker cross sections and longer lifetimes, compound nucleus-like processes. 17 figs.; 26 refs.

44537 **(GANIL-P—86-26) Hot nuclei, limiting temperatures and excitation energies.** Peter, J. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). Sep 1986. 17p. (CONF-8609159—8). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752357.

From International school-seminar on heavy ion physics; Dubna, USSR (23 Sep 1986).

Hot fusion nuclei are produced in heavy ion collisions at intermediate energies (20-100 MeV/U). Information on the maximum excitation energy per nucleon -and temperatures- indicated by the experimental data is compared to the predictions of static and dynamical calculations. Temperatures around 5-6 MeV are reached and seem to be the limit of formation of thermally equilibrated fusion nuclei.

44538 **(IPNO-DRE—86-12) /sup 73/Ge(d,/sup 3/He)/sup 72/Ga reaction.** Rotbard, G., Vergnes, M.; Berrier-Ronsin, G.; Vernotte, J.; Tamisier, R. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1986. 22p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87752340.

The odd-odd nucleus /sup 72/Ga has been studied via the /sup 73/Ge(d,/sup 3/He)/sup 72/Ga reaction at 25.2 MeV, with 9 keV resolution full width at half maximum, using a tandem accelerator and a split pole spectrometer. The spectroscopic factors are determined for 40 levels, some of which previously unknown. All the observed levels have negative parity; limits for the spin value J are given and possible main configurations are suggested. The occupation numbers of the proton orbitals in /sup 73/Ge have been determined: this nucleus appears in this respect as more similar to the heavier even Ge isotopes than to the lighter ones.

44539 **Shape coexistence in the Z=78-82 region.** Zganjar, E.F.; Wood, J.L.; Papanicolopoulos, C.; Kortelahti, M. (Louisiana State Univ., Baton Rouge, LA 70803). pp 716-725 of Nuclear structure, reactions and symmetries. Meyer, R.A.; Paar, V. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-8606130—).

From International conference on nuclear structure, reactions, and symmetries; Dubrovnik, Yugoslavia (5 Jun 1986).

Shape coexistence in the Z=78-82 region is described; and results from the spectroscopic studies on odd-mass Au isotopes at UNISOR are used to illustrate shape coexistence and to show how one can utilize an odd particle to probe the even-even core to expose the finer details of the coexisting structures in those cores. Results from other measurements in the region are discussed and the applicability of a picture describing the origin of coexistence in terms of the interaction of particles in an intruder state configuration with valence particles of the other kind is demonstrated.

6517 Nuclear Properties And Reactions, A=90-149, Experimental

44540 (ANL-PHY—86-1, pp 511-518) **Entry states in subbarrier fusion.** Halbert, M.L.; Beene, J.R.; Hensley, D.C.; Honkanen, K.; Semkow, T.; Abenante, V.; Sarantites, D.G. (Oak Ridge National Lab., TN). 1986. NTIS, PC A99/MF A01. File Number DE87010055. (CONF-860396—). Contract AC05-84OR21400;AC02-76ER04052.

From Symposium on the many facets of heavy ion fusion reactions; Argonne, IL, USA (24 Mar 1986).

The spin spectrometer in coincidence with identified products from two reactions leading to the same compound nucleus, ytterbium 164, has been used to study entry-state angular momentum effects in sub-barrier fusion. The systems nickel 64 + molybdenum 100 and oxygen 16 + samarium 148 were studied at energies from 81 Mev to 210 Mev. Cross sections for the four dominant exit channels, 2n, 4n, alpha2n and 3n, as well as fusion cross sections are presented. Results compare well to statistical model calculations.

44541 **(DOE/ER/04831—10) Double beta decay of molybdenum 100: Annual progress report for period January 1, 1987-December 31, 1987.** Nicholson, H.W. (Mount Holyoke Coll., South Hadley, MA (USA)). Jul 1987. Contract AC02-78ER04831. 9p. (COO—4831-10). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010384.

Work is continuing on a collaborative experiment with experimenters from the Lawrence Berkeley Laboratory to search for neutrinoless and two neutrino double beta decays in ^{100}Mo. Backgrounds in a detector stack consisting of 40 lithium-drifted, surface-barrier silicon detectors within a titanium cryostat shielded by 10 inches of lead, 2-4 inches of borated polyethylene, and 2 feet of wax 4000 feet underground have been studied with no ^{100}Mo foils inserted, and, under these conditions, no background events simulating double beta decay candidates have survived cuts in an energy region extending from 2.55 to 3.5 MeV in approximately 1600 hours of running. In addition, using 20 ^{100}Mo foils from a second batch of ^{100}Mo obtained from Oak Ridge comprising a total of approximately 1/6 mole (1.04×10^{23} atoms) of ^{100}Mo, we have very recently obtained in only 400 hours of running a very preliminary one sigma lower limit on the lifetime estimate for zero neutrino double beta decay, based on one count, of greater than 2×10^{21} years (approximately 2×10^{22} years Ge equivalent) and an equally preliminary one sigma lower limit on the lifetime estimate for two neutrino double beta decay, based on excess counts in the ^{100}Mo spectrum over the empty detector spectrum, of greater than 2×10^{19} years (approximately 1.5×10^{21} years Ge equivalent). In 400 hours, we have no candidates for majoron double beta decay. 2 figs.

44542 **(INIS-mf—10639) Quasiparticle-excitations in light even-even barium nuclei.** Schiffer, K.J.M. (Koeln Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet). 8 Feb 1986. 151p. (In German). NTIS (US Sales Only), PC A08/MF A01. File Number DE87752443.

The nucleus /sup 126/Ba was investigated by inbeam gamma-ray spectroscopy using the /sup 116/Sn(/sup 13/C,3n)/sup 126/Ba reaction. γ-singles spectra, γ-angular distributions, γ-excitation functions and γγ-coincidences were measured, partially by the use of anticompton techniques. 54 excited states were established and 83 γ-lines were placed into the level scheme of /sup 126/Ba. Several spin and parity assignments were made. More than 14 mean lifetimes of excited states in /sup 126/Ba were determined by an RDDS-measurement. Here the /sup 100/Mo(/sup 30/Si,4n)/sup 126/Ba reaction was used in order to populate excited states of /sup 126/Ba. The experimental Routhians of the observed bands are analyzed with the symmetric Cranked Shell Model (CSM). In addition 2-quasiparticle Routhians are constructed from the single particle configurations of the neighbouring odd nuclei of /sup 126/Ba, /sup 128/Ba and /sup 130/Ba and were then compared with the negative parity bands of the even-even nuclei. Both analysis show the h/sub 11/2/g/sub 7/2/-neutron character of the strongly coupled bands and the 2-quasi-proton character of the more decoupled band structures. The mean residual interaction could be determined to be about -200 keV to -300 keV for the neutron bands and be-

tween -300 keV and -550 keV for the proton bands in the Barium nuclei. (orig./HSI).

44543 **(INIS-mf—10641) Structure studies on the heavy isotopes /sup 100/Mo, /sup 102/Mo, and /sup 104/Mo via the β decay of the Nb fission products.** Menzen, G. (Koeln Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet). 29 Jun 1985. 79p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE87752441.

At the fission product separator JOSEF a superconducting magnet was installed which permits the determination of the g factors of excited levels of fission products. In the framework of this thesis the g factors of the 2/sub 1//sup +/ levels of the neutron-rich isotopes /sup 102/Mo and /sup 104/Mo were measured. It resulted g = 0.42 +- 0.07 for /sup 102/Mo and g = 0.19 /sub -0.10//sup +0.12/ for /sup 104/Mo. These values were compared with other g factors of neighbouring nuclei in order to obtain from this a statement about the g factors of the proton respectively neutron bosons g/sub π/ and g/sub ν/ derived in the IBA model. Furthermore from the measured g factors for the /sup 100/Zr an effective proton boson number of N/sub π/ = 1.4 +- 0.7 was calculated which means that the subshell closure at the Z=40 is further valid for N=60. In the second part of the thesis the decay of the /sup 100/Nb and the level scheme of the /sup 100/Mo was studied. From B/sub 9/ distribution, β half-lives, and γ-γ coincidence measurements the term scheme of the /sup 100/Mo could be established from the high spin decay of the /sup 100/Nb. By the study of the β feedings a spin of the high spin isomer I/sup π/ = 4/sup +/ could be concluded. This isomer can by shell model considerations be interpreted as πg/sub 9/2/ x νs/sub 1/2/ configuration. In γ-γ angular correlations further excited 0/sup +/ levels in the /sup 100/Mo were detected. Furthermore δ mixing parameters for two 2-2 transitions could be given with δ = 4.4 /sub -0.9//sup +1.5/ for 2/sub 1//sup +/-2/sub 2//sup +/ and δ = 0.27 +- 0.12 for 2/sub 3//sup +/-2/sub 1//sup +/. According to the vibrational model by means of the obtained data an assignment of some levels to the single phonon excitations was performed. Indeed the low lying 0/sub 2//sup +/ state is not compatible with the vibrational model.

44544 **(INIS-mf—10653) Antiproton-nucleus interaction and nuclear E2 resonance effect in molybdenum and neodymium isotopes.** Kanert, W. (Technische Univ. Muenchen, Garching (Germany, F.R.). Fakultaet fuer Physik). 10 Jun 1986. 167p. (In German). NTIS (US Sales Only), PC A08/MF A01. File Number DE87752452.

Antiprotonix X-radiation from /sup 92/Mo, /sup 94/Mo, /sup 95/Mo, /sup 98/Mo, /sup 100/Mo and /sup 146/Nd, /sup 148/Nd was measured with Ge detectors at the LEAR (CERN). The nuclear E2 resonance effect (configuration mixing by dynamic electric quadrupole interaction) was for the first time observed in antiprotonic atoms. It effects in /sup 94/Mo, /sup 95/Mo, and /sup 98/Mo a mixing of the atomic levels (7,6) and (5,4). From the resulting weakening of the antiprotonic X-ray line (7->6) in comparison with the nonresonant isotope /sup 92/Mo information on the effects of the strong interaction in the (5,4) level was obtained which is in Mo not directly observable. The absorption widths by strong interactions in the level (6,5) resulted for /sup 92/Mo, /sup 94/Mo, /sup 95/Mo, and /sup 98/Mo to 1.4 +- 0.3 keV, 2.3 +- 0.9 keV, 1.9 +- 0.4 keV, and 2.3 +- 0.7 keV, the energy shifts by strong interactions to 0.46 +- 0.08 keV, 0.64 +- 0.22 keV, 0.74 +- 0.12 keV, and 0.55 +- 0.16 keV. In the nonresonant isotope /sup 92/Mo the absorption width of the level (7,6) to 19.5 +- 1.2 eV. A fit of the effective scattering length to the data for /sup 92/Mo resulted anti a = (0.25 + 3.05i) fm. In /sup 100/Mo the predicted case of strong coupling could be experimentally established by the nearly complete extinction of the line (8->7) and the broadening of the line (9->8). In /sup 148/Nd the nuclear E2 resonance effect effects a mixing of the levels (9,8) and (8,6) and by this a reduction of the line (9->8) in comparison to /sup 146/Nd. For this isotope information on the effects of the strong interaction could be extracted separately for the fine structure components.

44545 (JAERI-M—87-025, pp 262-272) **Measurement of the fast neutron cross sections at the JAERI tandem accelerator facility.** Chiba, S.; Yamanouti, Y.; Mizumoto, M.; Sugimoto, M.; Kawarasaki, Y.; Hyakutake, M.; Iwasaki, S. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Feb 1987. NTIS (US Sales Only), PC A16/MF A01. File Number DE87900676. (NEANDC(J)—123/U; INDC(JPN)—109/L; CONF-8611159—).

From Seminar on nuclear data; Tokai, Japan (26 Nov 1986).

The fast neutron time-of-flight and (n,xγ) spectrometers installed at the JAERI tandem accelerator can provide the neutron nuclear data between En = 5 and around 30 MeV region. This paper presents an overview of the facility and methods of the fast neutron cross section measurements there. Some preliminary results of the recent experiments are also described.

44546 **Fission product yields for fast-neutron fission of /sup 243,244,246,248/Cm.** Dickens, J.K. (Oak Ridge National Lab., Oak Ridge, TN 37831). *Nuclear Science and Engineering;* **96**: No. 1, 8-16(May 1987). Contract AC05-84OR21400.

Recent measurements of relative yields for /sup 95/Zr, /sup 125/Sb, /sup 137/Cs, /sup 141/Ce, /sup 144/Ce, and /sup 155/Eu for fast-neutron fission of samples enriched in the actinides /sup 243,244,246,248/Cm have been combined with a simple mass-distribution model to predict complete mass distributions for fast-neutron fission of each of these four curium actinides. Complete descriptions of the data analysis and of the model and its application and limitations are given.

44547 **The thermal neutron capture cross sections and resonance integrals of /sup 144/Sm and /sup 145/Sm.** Alexander, C.W.; Halperin, J.; Knauer, J.B.; Walker, R.L. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN 37831). *Nuclear Science and Engineering;* **95**: No. 3, 194-199(Mar 1987). Contract AC05-84OR21400.

Two-group integral neutron capture cross sections have been measured for /sup 144/Sm and /sup 145/Sm. Mass spectrographic assays were carried out on highly enriched samples of /sup 144/Sm that were irradiated in a high-flux nuclear reactor making use of cadmium filters and cobalt as a flux monitor. Under the assumption that these nuclides have a (1/v) dependence in the thermal region, the following are reported: for /sup 144/Sm, σ/sup c//sub 2200/ = 1.64 +- 0.10 and I/sup c/ = 2.38 +- 0.17 b; for /sup 145/Sm, σ/sup c//sub 2200/ = 280 +- 21 and I/sup c/ = 600 +- 90 b.

44548 **An example of a U(5) nucleus.** Aprahamian, A. (Nuclear Chemistry Div., Lawrence Livermore National Lab., Livermore, CA 94550). pp 671-675 of Nuclear structure, reactions and symmetries. Meyer, R.A.; Paar, V. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-8606130—). Contract W-7405-ENG-48.

From International conference on nuclear structure, reactions, and symmetries; Dubrovnik, Yugoslavia (5 Jun 1986).

Evidence is shown for the observation of five-closely spaced states in /sup 118/Cd with a centroid at 1989 keV which may represent the first identification of all five members of the three-phonon quintuplet.

6518 Nuclear Properties And Reactions, A=150-189, Experimental

44549 **Neutron capture cross sections of /sup 151/Eu and /sup 153/Eu from 3 to 2200 keV.** Macklin, R.L.; Young, P.G. (Oak Ridge National Lab., Oak Ridge, TN 37831). *Nuclear Science and Engineering;* **95**: No. 3, 189-193(Mar 1987).

Neutron capture by enriched stable isotopes of europium was measured as a function of energy by time of flight at the Oak Ridge Electron Linear Accelertor. Deformed optical model and reaction theory calculations using the published total cross section for natural europium and low-energy resonance parameters were made to compare with the present data. Maxwellian average capture at

kT = 30 keV was calculated as (3.40 +- 0.14) b for /sup 151/Eu and (2.48 +- 0.10) b for /sup 153/Eu.

6519 Nuclear Properties And Reactions, A=190-219, Experimental

44550 (DOE/ER/03346—278) **Nuclear chemistry research and spectroscopy with radioactive nuclei: Twenty-third annual progress report.** Fink, R.W. (Georgia Inst. of Tech., Atlanta (USA). School of Chemistry). 31 Aug 1987. Contract AS05-76ER03346. 52p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87014046.

Research supported in part by this contract has become totally devoted to the study of far-from-stable radioactive nuclei with the UNISOR facility [University Isotope Separator at Oak Ridge] on-line with HHIRF [Holifield Heavy Ion Research Facility]. The purpose of these UNISOR studies is to investigate the low-spin (<21/2), low-energy (<3 MeV) nuclear structures and stability, most of which are not generally accessible by in-beam spectroscopic methods. The UNISOR facility isotope separator provides the mass selection needed for detailed nuclear spectroscopy following radioactive decay and enables one to test critically the competing theoretical concepts and calculations from nuclear models. The UNISOR studies are centered on cases where an odd valence nucleon or valence pair of nucleons act as probes of the characteristics of the core. This leads to observations of abrupt shape changes, shape coexistence, and shell-model intruder states in the region of low nuclear excitation energy. Detailed singles and $\gamma\gamma t$, $e^-\gamma t$, $X\gamma t$, and $\alpha\gamma t$ multiparameter coincidence measurements are carried out, and soon measurements of singles γ-ray angular distributions and magnetic moments of mass-separated, low-temperature oriented nuclei will begin using the helium dilution refrigerator on-line to the isotope separator. In particular, what is reported centers on two neutron-deficient regions of interest, one around the Z = 82 closed shell (from Z = 77 to 85) and the other in the rare earths around the new region of deformation at N < 76 and Z > 56. 30 refs., 15 figs., 8 tabs.

6520 Nuclear Properties And Reactions, A=220 And Above, Experimental

44551 (JAERI-M—87-025, pp 19-32) **Actinide nuclear data for nuclear fuel cycles.** Yoshida, T.; Hida, K. (Nippon Atomic Industry Group Co. Ltd., Kawasaki, Kanagawa. Nuclear Research Lab.). Feb 1987. NTIS (US Sales Only), PC A16/MF A01. File Number DE87900676. (NEANDC(J)—123/U; INDC(JPN)—109/L; CONF-8611159—).

From Seminar on nuclear data; Tokai, Japan (26 Nov 1986).

Roles of the neutron reactions in actinide-nuclide transmutation are reviewd briefly as well as the status of measured and evaluated data. Special attention is paid on the threshold reaction (n,2n), which is one of key reactions linking the actinide transmutation chains. Need for improving accuracy of the (n,2n) cross sections of Pu-239 and Np-237 is stressed.

44552 (JAERI-M—87-025, pp 174-189) **Resonance parameters of /sup 238/U.** Nakagawa, Tsuneo. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Feb 1987. NTIS (US Sales Only), PC A16/MF A01. File Number DE87900676. (NEANDC(J)—123/U; INDC(JPN)—109/L; CONF-8611159—).

From Seminar on nuclear data; Tokai, Japan (26 Nov 1986).

The present status of experimental and evaluated resonance parameters of /sup 238/U are briefly reviewed. The parameters stored in JENDL-2 are accurate enough for low lying levels. At high energies, activities of NEANDC Task force on /sup 238/U discrepancies are summarized. For JENDL-3, the resonance parameters will be evaluated up to 10 keV, if possible, by taking into account new values of parameters obtained by Olsen. Tentative calculation from the Olsen's parameters is shown.

44553 (JAERI-M—87-025, pp 190-204) **Pu-239 nuclear data.** Kawai, M. (Nippon Atomic Industry Group Co. Ltd., Kawasaki, Kanagawa. Nuclear Research Lab.). Feb 1987. NTIS (US Sales Only), PC A16/MF A01. File Number DE87900676. (NEANDC(J)—123/U; INDC(JPN)—109/L; CONF-8611159—).

From Seminar on nuclear data; Tokai, Japan (26 Nov 1986).

Some remarks on the nuclear data of Pu-239 are presented from viewpoint of HCLWR study. Resolved resonance parameters for JENDL-2 are on the basis of the data evaluated by Ribon, with the single level Breit-Wigner formulas. It is, however, pointed out that the interference effect between resonance levels upon the fission cross section is significant and multi-level formalism must be adopted to future evaluated data file. Recent experimental data for fission cross sections and multiplicities of prompt fission neutrons are also compared with the JENDL-2 data. The simultaneous evaluation of fission cross sections for main important actinides shows that Pu-239 fission cross sections in 50 keV - 1 MeV become smaller by 1 - 5 % than JENDL-2. This result may be discrepant with the requirement for JENDL-2 data modication, proposed from the integral test. The discrepancy between the differential and integral data may be reduced to some degree by slightly larger values of recently measured multiplicity of prompt fission neutrons below 100 keV.

44554 (JAERI-M—87-025, pp 230-240) **JENDL special purpose data files.** Iijima, S.; Kawai, M.; Katakura, J.; Nakazawa, M.; Asami, T.; Nakagawa, T. (Nippon Atomic Industry Group Co. Ltd., Tokyo). Feb 1987. NTIS (US Sales Only), PC A16/MF A01. File Number DE87900676. (NEANDC(J)—123/U; INDC(JPN)—109/L; CONF-8611159—).

From Seminar on nuclear data; Tokai, Japan (26 Nov 1986).

An ad-hoc JNDC committee on special purpose data file discussed the general and specific features of the JENDL Special Purpose Data Files. And several special purpose data files were proposed. Brief sketch of the proposed files and the status of the some selected data are described.

44555 (JAERI-M—87-025, pp 302-311) **Recent measurements of neutron cross section with KURRI-linac.** Fujita, Yoshiaki; Kobayashi, Katsuhei; Oigawa, Hiroyuki; Yamamoto, Shuji; Kimura, Itsuro. (Kyoto Univ., Kumatori, Osaka, Japan. Research Reactor Inst.). Feb 1987. NTIS (US Sales Only), PC A16/MF A01. File Number DE87900676. (NEANDC(J)—123/U; INDC(JPN)—109/L; CONF-8611159—).

From Seminar on nuclear data; Tokai, Japan (26 Nov 1986).

At the Research Reactor Institute, Kyoto University(KURRI), the 46 MeV electron linear accelerator has been used as a powerful and useful tool to have (1) time-of-flight measurements, such as neutron cross section and neutron spectrum for reactor materials, (2) irradiation experiments for isotope production, (3) radiation damage studies in a liquid nitrogen temperature, and so on. In this paper, in order to assess the evaluated nuclear data for /sup 181/Ta or /sup 232/Th in JENDL-2 and ENDF/B-IV, two studies are introduced from the recent results concerning (1) the experimental check of the self-shielding effects for /sup 181/Ta, and (2) measurement of the /sup 232/Th resonance parameters, and the integral check of the parameters by comparing with the resonance integral measured in the standard 1/E neutron spectrum field.

44556 **Decay of /sup 100/Sr and a "pairing-free" K/sup π/ = 1^+ rotational band in odd-odd /sup 100/Y.** Wohn, F.K.; Hill, J.C.; Winger, J.A.; Petry, R.F.; Goulden, J.D.; Gill, R.L.; Piotrowski, A.; Mach, H. (Ames Laboratory and Iowa State University, Ames, Iowa 50011). *Physical Review [Section] C: Nuclear Physics;* **36**: No. 3, 1118-1128(Sep 1987). Contract W-7405-ENG-82.

The decay of /sup 100/Sr (193 ms) to the low-spin /sup 100/Y isomer (735 ms) was studied from mass-separated activity produced in thermal neutron fission of /sup 235/U. γ singles and γ-γ coincidence measurements resulted in the placement of 67 γ transitions in a decay scheme with 26 levels below 2 Mev. The multipolarities of low-energy transitions were determined from internal

conversion electron measurements. Logft values were deduced using an absolute γ-ray intensity determination for the A = 100 decay chain. The 1^+ levels in /sup 100/Y at 10.70 and 974.61 keV each receive —40% of the β feeding from /sup 100/Sr. A K/sup π/ = 1^+ rotational band (with 1^+, 2^+, and 3^+ levels at 10.70, 76.15, and 172.03 keV) is proposed which can be characterized as a nearly "pairing-free" band. Other levels in /sup 100/Y are discussed in terms of two-quasiparticle Nilsson orbitals.

44557 Nuclear spins and moments of the actinides. Conway, J.G. (Lawrence Berkeley Lab., CA, USA). pp 1647-1648 of Chemistry of the actinide elements. Vol. 2. 2. Ed . Katz, J.J.; Morss, L.R.; Seaborg, G.T. (eds.). London, England; Chapman and Hall (1986).

Price Pound 110.00.

The table lists the element and atomic mass in the first two columns. The nuclear spin (I) is in column 3. The magnetic dipole moment (μ) in units of nuclear magnetons is in column 4. The spectroscopic electric quadrupole moment (Q) in units of barns is in column 5. References are given where this information has been tabulated and reference to the original work may be found.

44558 Nuclear properties of actinide nuclides. Ahmad, I.; Fields, P.R. (Argonne National Lab., IL, USA). pp 1649-1674 of Chemistry of the actinide elements. Vol. 2. 2. Ed . Katz, J.J.; Morss, L.R.; Seaborg, G.T. (eds.). London, England; Chapman and Hall (1986).

Price Pound 110.00.

This is a comprehensive compilation of nuclear properties of known isotopes of the elements of atomic number 89 to 109. Data on half-lives, modes of decay, main radiations, methods of production and specific activities for the major decay modes are given. The tables are preceeded by a brief and elementary discussion of the nuclear properties of heavy elements.

6530 Nuclear Theory

REFER ALSO TO CITATION(S) 44376, 44421, 44483, 44486, 44501, 44501, 44504, 44504, 44515, 44528, 44539, 44604

44559 (CEA-CONF—8774) Hydrodynamics of quark-gluon plasmas. Blaizot, J.P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Fondamentale (IRF)). Jun 1986. 42p. (CEA-SPhT—86-141; CONF-8606294—2). NTIS (US Sales Only), PC A03/MF A01. File Number DE87752219.

From 26. Kracow school on theoretical physics; Zakopane, Poland (1 Jun 1986).

This paper reviews some aspects of the hydrodynamics of quark-gluon plasmas. Various stages of ultra-relativistic heavy ion collisions are described. Several estimates of the maximum energy density expected to be achieved in these collisions are compared. Discontinuities which may be induced in the hydrodynamic flow by a phase transition are described and a convenient numerical method designed to deal with such discontinuous flows is briefly presented. Finally, the correlations between particle transverse momenta and multiplicities are analyzed and one discusses to which extent these correlations could signal the occurrence of a phase transition in heavy ion collisions.

44560 (DOE/ER/02171—227) Statistical nuclear spectroscopy: New methods and applications; level densities and related functions for interacting-particle nuclei. Smith, J.F. III. (Rochester Univ., NY (USA). Dept. of Physics and Astronomy). 1987. Contract AC02-76ER02171. 133p. (UR—1023). NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87014043.

This thesis develops a new theory of state densities for interacting particle (IP) systems of nucleons. This is a general theory, based on central limit theorems and unitary group decomposition of the microscopic Hamiltonian. The density appears in terms of convolutions of noninteracting particle (NIP) densities with easily calculable interaction functions given explicitly in terms of Hamiltonian matrix elements. This allows for easy incorporation of interaction information and yields simple expressions that are much more compact than any previous spectral averaging theory of state densities. The convolution form for the state density is shown to extend to the expectation of one-body and two-body operators, this having immediate application to the calculation of occupancies and spin cut-off factors. A compact method of calculating the state density is developed and, for NIP, is compared to the exact procedure with excellent results this allowing extension of statistical spectroscopy to indefinitely large spaces. By using the new NIP plus convolution results ab initio calculations of fixed-J level densities in the resonance region have been done with very high accuracy for 37 nuclei. The associated interaction strengths for sample nuclei are given. Tables of state density parameters (for a two parameter form) calculated by fitting to statistical spectroscopic results as well as the parameters for reproducing the energy dependence of the spin-cut-off factor are given. The spin cut-off factors are shown to exhibit excellent agreement with results obtained from empirical fitting to experimental data by other authors. 44 refs., 13 figs., 16 tabs.

44561 (DOE/ER/40150—33) Panic '87 conference: 11th international conference on particles and nuclei: Summary session. Walecka, J.D. (Continuous Electron Beam Accelerator Facility, Newport News, VA (USA)). 1987. Contract AC05-84ER40150. 14p. (CEBAF-PR—87-020; CONF-870413—6). NTIS, PC A02/MF A01; GPO Dep. File Number DE87012467.

From 11. international conference on particles and nuclei; Kyoto, Japan (20 Apr 1987).

The author reviews nuclear physics from a nontechnical and historical perspective. He discusses the justification for nuclear research, quantum electrodynamics, and the standard electroweak model. 13 refs., 7 figs. (DWL)

44562 (GANIL-P—86-28) Study on the disintegration of highly excited nuclei with the Vlasov-Uehling-Uhlenbeck equation. Vinet, L.; Gregoire, C.; Schuck, P.; Remaud, B.; Sebille, F. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). 1986. 50p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87752358.

The disintegration of hot and/or compressed nuclei is studied using (I) the Vlasov equation (VE) with imposed spherical symmetry (II) the VE in three dimensions (3D) (III) the VE in three dimensions supplemented by the Uehling-Uhlenbeck collision term (VUU). We find that case ii) is slightly more unstable with respect to disintegration compared to case (I) whereas (III) tends to make nuclei more stable. In all cases the thermal energies (15-20 MeV per nucleon) needed to totally disintegrate a nucleus seem to be higher than those found in static and hydrodynamic calculation. On the contrary, compressional energy very much helps disintegration. Some comments on the introduction of fluctuations and corresponding fragmentation are added.

44563 (INIS-BR—712) Proceedings of the 8. Workshop on Nuclear Physics. (Sociedade Brasileira de Fisica, Rio de Janeiro). 1985. 271p. (In Portuguese). (CONF-8508241—). NTIS (US Sales Only), PC A12/MF A01. File Number DE87703464.

From 8. workshop on nuclear physics; Sao Lourenco, MG, Brazil (31 Aug 1985).

Several lectures on Nuclear Physics and some related works are presented in this proceeding of the 8. Workshop in Nuclear Physics which was held in Sao Lourenco, Brazil, 1985. (L.C.).

44564 (INIS-BR—712, pp 46-78) Two phase transitions in Nuclear Physics. Bes, D.R. (Comission Nacional de Energia Atomica, Buenos Aires, Argentina. Dept. de Fisica). 1985. (In Spanish). NTIS (US Sales Only), PC A12/MF A01. File Number DE87703464. (CONF-8508241—).

From 8. workshop on nuclear physics; Sao Lourenco, MG, Brazil (31 Aug 1985).

The status of the art of the problem associated with two phase transitions in the nuclear matter, viz.: the disappearance of the nuclear superfluiditiy with the raising of the rotation velocity and the appearance of an octupolar deformation in the actinide zone, is presented. (L.C.).

44565 (INIS-BR—712, pp 19-45) **Heavy ion reactions at low energies.** Nemes, M.C. (Sao Paulo Univ., Brazil. Inst. de Fisica). 1985. (In Portuguese). NTIS (US Sales Only), PC A12/MF A01. File Number DE87703464. (CONF-8508241—).

From 8. workshop on nuclear physics; Sao Lourenco, MG, Brazil (31 Aug 1985).

Some general features of the heavy ion reactions at low energies are presented. Some kinds of processes are studied, such as: elastic scattering, peripherical reactions, deep inelastic collisions and fusion. Both, theoretical and experimental perspectives on this field are discussed. (L.C.).

44566 (INIS-BR—712, pp 81-90) **Reaction mechanisms in collisions between heavy ion at intermediate energies.** Donangelo, R.J. (Rio de Janeiro Univ., Brazil. Inst. de Fisica). 1985. (In Portuguese). NTIS (US Sales Only), PC A12/MF A01. File Number DE87703464. (CONF-8508241—).

From 8. workshop on nuclear physics; Sao Lourenco, MG, Brazil (31 Aug 1985).

Pion emission at E/sub lab/ < —, 290 MeV/nucleon energies (threshold for pion production in nucleon-nucleon collisions) and nuclear multifragmentation processes are discribed. The former process gives information about the degree of collectivity of the nuclear system in the intermediate energie range while with the later its is possible to study the equation of state of the nuclear matter in the 0.17fm/sup -/3, T < —, 15 MeV region. (L.C.).

44567 (INIS-BR—712, pp 91-115) **Photofission and electrofission by virtual photon methods.** Onley, D.S. (Ohio Univ., Athens, USA). 1985. NTIS (US Sales Only), PC A12/MF A01. File Number DE87703464. (CONF-8508241—).

From 8. workshop on nuclear physics; Sao Lourenco, MG, Brazil (31 Aug 1985).

A survey on photofission and electrofission using virtual photon methods is presented. Some explicit calculations with these methods are shown and applications to heavy nucleus reactions followed of comparison with experiments, mostly electrofission, are also shown. (L.C.).

44568 (UCRL—97081) **Fission barriers of hot rotating nuclei: Theoretical predictions and experimental tests.** Mustafa, M.G. (Lawrence Livermore National Lab., CA (USA)). 7 Jul 1987. Contract W-7405-ENG-48. 34p. (CONF-8706182—1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013114.

From All-Union symposium on physics of nuclear fission; Obninsk, USSR (2 Jun 1987).

Recent theoretical developments in calculating fission barriers of hot rotating nuclei and their experimental tests are reviewed. The discussions are limited to macroscopic fission models (no shell effects), since experimental tests come primarily from heavy-ion induced reactions involving large angular momenta and internal excitation energies. The physics of the rotating finite range models with temperature is emphasized and the predictions of our model are compared with those of other macroscopic models and with statistically deduced experimental results. The difficulties associated with the statistical model analysis at high temperatures are discussed. 43 refs., 8 figs., 1 tab.

44569 (UCRL—97153) **Relativistic 3-D nuclear hydrodynamics with Monte Carlo pions.** Zingman, J.A.; McAbee, T.L.; Wilson, J.R.; Alonso, C.T. (Lawrence Livermore National Lab., CA (USA)). May 1987. Contract W-7405-ENG-48. 12p. (CONF-870543—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013795.

From 2. workshop on experiments and detectors for relativistic heavy ion collider; Berkeley, CA, USA (25 May 1987).

A model for relativistic three-dimensional hydrodynamical nuclear fluids has been coupled to a Monte Carlo pion model which treats the production, scattering, and absorption of pions in relativistic nuclear fluids. The model is dynamic and allows us to explicitly follow the temporal and spatial development of pion components through an entire collision process and into the final state. Such calculations will be necessary to extract meaningful information from measured RHIC pion distributions. We present preliminary results and discussion for $^{139}La + {}^{139}La$ collisions at 1350 MeV/nuc (lab) and at various impact parameters. 13 refs., 2 figs.

44570 **European Muon Collaboration effect in the hybrid quark-hadron model.** Kisslinger, L.S.; Johnson, M.B. (Physics Department, Carnegie-Mellon University, Pittsburgh, Pennsylvania 15213 and Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] C: Nuclear Physics;* **36**: No. 3, 1081-1084(Sep 1987).

Deep inelastic structure functions are derived in the hybrid quark-hadron model with three methods for including binding. With light-front dynamics, the European Muon Collaboration effect is shown to be consistent with this model, with an internal six-quark structure region of average probability of about 20% in medium-mass nuclei, as found in exclusive electron scattering on light nuclei; while instant-form dynamics is not consistent with the model.

44571 **Generalized impulse approximation for relativistic proton scattering.** Tjon, J.A.; Wallace, S.J. (Institute for Theoretical Physics, University of Utrecht, 3508 TA Utrecht, The Netherlands). *Physical Review [Section] C: Nuclear Physics;* **36**: No. 3, 1085-1104(Sep 1987).

A complete set of Lorentz invariant nucleon-nucleon amplitudes, based on a meson-exchange model and on-mass-shell kinematics, is used to construct the impulse approximation optical potential for use in the Dirac equation. Relativistic nuclear densities are also used in the construction. No free parameters enter. The analysis provides a dynamical basis for the virtual pair couplings which are implicit in the Dirac equation for proton-nucleus scattering. A momentum space potential and a localized potential suitable for coordinate space analysis are developed. Initial numerical calculations are presented for proton scattering by /sup 40/Ca at 200, 500, and 800 MeV. The generalized impulse approximation provides a successful description of the elastic scattering data for these cases. Low energy results are improved substantially in comparison with the original form of Dirac impulse approximation based on using five Fermi amplitudes to represent nucleon-nucleon scattering.

44572 **Neutral pion production cross sections in heavy ion collisions from 80 to 219 MeV/nucleon.** Sullivan, J.P. (Cyclotron Institute, Texas A&M University, College Station, Texas 77843). *Physical Review [Section] C: Nuclear Physics;* **36**: No. 3, 1200-1201(Sep 1987).

Using previously published differential cross sections for the production of charged pions at forward angles, total cross sections for neutral pion production in Ne+NaF collisions from 80 to 219 MeV/nucleon are estimated.

44573 **Cross sections for two-body sequential decay reactions.** Baker, M.D.; Knox, H.D.; Breitenberger, E. (Ohio Univ., Dept. of Physics and Astronomy, Athens, OH 45701). *Nuclear Science and Engineering;* **96**: No. 1, 39-45(May 1987).

A general procedure is given for calculating the double differential cross section for a two-body sequential decay reaction, given the angular distributions for the initial and decay reactions. The kinematics, reference frame transformations, and the Jacobians required for transforming the cross sections are developed for the general two-body sequential decay reaction.

44574 **Relativistic effects in nuclear physics.** Brown, G.E.; Weise, W.; Baym, G.; Speth, J. (State Univ. of New York, Stony Brook, USA. Dept. of Physics; Los Alamos National Lab., NM, USA). *Comments on Nuclear and Particle Physics;* **17**: No. 1, 39-62(1987).

Relativistic effects in nuclear physics, especially those in nuclear structure, are discussed. While general arguments are given which exclude several recently proposed effects, two important relativistic effects remain: (1) A strongly density-dependent repulsive term in the energy per particle (deltaepsilon)sub(rel) approx.2(p/psub(o)sup(8/3)Mev, where psub(o) is nuclear matter density, arises from virtual pair terms; this term is very important in saturating nu-

clear matter. (2) The nucleon-nucleon spin-orbit interaction is enhanced, since the nucleon mass which enters into this interaction is effectively changed locally by scalar fields which connect to negative energy states.

44575 **Quark deconfinement and high energy nuclear collisions.** Satz, H. (Brookhaven National Lab., Upton, NY 11973). pp 1424-1429 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—). Contract AC02-76CH00016.

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

This statistical QCD study predicts that with increasing density, strongly interacting matter undergoes a transition to a plasma of deconfined quarks and gluons. High energy heavy ion collisions are expected to permit experimental studies of this transition and of the predicted new state of matter.

44576 **An experimental study of the A-dependence of J/PSI photoproduction.** Sokoloff, M.D.; Anjos, J.C.; Appel, J.A.; Bracker, S.B.; Browder, T.E.; Cremaldi, L.M.; Elliott, J.R.; Escobar, C.O.; Estabrooks, P.; Gibney, M.C. (The Fermilab Tagged Photon Spectrometer Collaboration, P.O. Box 500, Batavia, IL 60510). pp 1396-1398 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

In an experiment using the Tagged Photon Spectrometer at Fermilab the authors study the photoproduction of J/psi mesons on hydrogen, beryllium, iron and lead targets. The p/sup 2//sub T/ spectra are used to separate the coherent different signals from the incoherent signals. The authors have parameterized the per nucleus cross sections in terms of power law dependences, A/sup α/. For a sample of approximately 1700psi $\rightleftharpoons$ μ/sup +/μ/sup -/ events with E/sub psi/ > 80 GeV this study finds that α=1.40 +- 0.06 +- 0.04 for the coherent diffractive signals and that α = 0.94 +- 0.02 +- 0.03 for the incoherent signals.

44577 **The EMC effect.** Berger, E.L. (High Energy Physics Div., Argonne National Lab., Argonne, IL 60439). pp 1433-1442 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

A review is presented of data and theoretical interpretations of the nuclear dependence of quark and antiquark distributions as observed in the deep inelastic scattering of neutrinos and charged leptons for nuclei. After a summary of the experimental situation and a survey of proposed explanations, the author concentrates on interpretations in terms of conventional nuclear physics and on the Q/sup 2/-rescaling approach. The review concludes with a list of desirable experiments.

44578 **Mixing of the ground band and two-particle four-hole intruder band in /sup 110/Cd.** Kusnezov, D.; Kern, J.; Heyde, K.; Meyer, R.A. (Physics Dept., Princeton Univ., Princeton, NJ 08544). pp 783-798 of Nuclear structure, reactions and symmetries. Meyer, R.A.; Paar, V. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-8606130—).

From International conference on nuclear structure, reactions, and symmetries; Dubrovnik, Yugoslavia (5 Jun 1986).

The intruder four-hole two-particle levels in /sup 110/Cd have been studied theoretically using recent data where evidence has been obtained for the "intruder" band extending to high-spin (J/sup π/ = 8/sup +/) states. These data are compared with IBM-2 calculations in order to investigate the extent of mixing between the ground-state and the 2p-4h intruder band. The observed excitation energies and the reduced B(E2) transition probabilities are used to demonstrate the large degree of mixing and the obfuscation of the simple character of both intruder and vibrational structure. Essential deviations from the standard quadrupole vibrational characteristics are conspicuous.

44579 **Octupole correlations in the heavy elements.** Chasman, R.R. (Physics Div., Argonne National Lab., Argonne, IL 60439-4843). pp 5-29 of Nuclear structure, reactions and symmetries. Meyer, R.A.; Paar, V. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-8606130—). Contract W-31-109-ENG-38.

From International conference on nuclear structure, reactions, and symmetries; Dubrovnik, Yugoslavia (5 Jun 1986).

The effects of octupole correlations on the nuclear structure of the heavy elements are discussed. The cluster model description of the heavy elements is analyzed. The relevance of 2/sup 6/-pole deformation and fast E1 transitions to an octupole model is considered.

44580 **The N/sub p/N/sub n/ scheme.** Casten, R.F. (Brookhaven National Lab., Upton, NY 11973). pp 698-705 of Nuclear structure, reactions and symmetries. Meyer, R.A.; Paar, V. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-8606130—). Contract AC02-76CH00016.

From International conference on nuclear structure, reactions, and symmetries; Dubrovnik, Yugoslavia (5 Jun 1986).

The use of the N/sub p/N/sub n/ scheme to simplify nuclear systematics, to unify the interpretation of different mass regions, to simplify collective model calculations, to disclose the evolution of subshell behavior, and to predict unknown nuclei far off stability is discussed.

44581 **The Interacting Boson Model and medium energy probes.** Ginocchio, J.N.; Wenes, G. (Theoretical Div., Los Alamos National Lab., Los Alamos, NM 87545). pp 483-490 of Nuclear structure, reactions and symmetries. Meyer, R.A.; Paar, V. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-8606130—).

From International conference on nuclear structure, reactions, and symmetries; Dubrovnik, Yugoslavia (5 Jun 1986).

Medium energy electron and proton scattering are used to determine the quadrupole form factors for the Interacting Boson Model of Nuclei.

44582 **Bose fermi symmetries and supersymmetry.** Warner, D.D. (Brookhaven National Lab., Upton, NY 11973). pp 148-167 of Nuclear structure, reactions and symmetries. Meyer, R.A.; Paar, V. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-8606130—). Contract AC02-76CH00016.

From International conference on nuclear structure, reactions, and symmetries; Dubrovnik, Yugoslavia (5 Jun 1986).

An overview of current problems and new results and directions in the study of bose-fermi symmetries and supersymmetries is given.

44583 **The SO(7) fermion dynamical symmetry and the Ru, Pd transitional region.** Casten, R.F.; Wu, C.L.; Feng, D.H.; Ginocchio, J.N.; Han, X.L. (Brookhaven National Lab., Upton, NY). pp 215-222 of Nuclear structure, reactions and symmetries. Meyer, R.A.; Paar, V. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-8606130—).

From International conference on nuclear structure, reactions, and symmetries; Dubrovnik, Yugoslavia (5 Jun 1986).

The possibility of Fermion Dynamical Symmetries is discussed and empirical evidence for an SO(7) symmetry in the Ru, Pd region is presented. This symmetry has the property that it describes (analytically), not a static structure, but rather a phase transitional region from vibrator towards γ-soft rotor.

44584 **Dynamical symmetries for odd-odd nuclei.** Balantekin, A.B. (Physics Div., Oak Ridge National Lab., Oak Ridge, TN 37831). pp 223-230 of Nuclear structure, reactions and symmetries. Meyer, R.A.; Paar, V. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-8606130—). Contract AC05-84OR21400.

From International conference on nuclear structure, reactions, and symmetries; Dubrovnik, Yugoslavia (5 Jun 1986).

Recent work for developing dynamical symmetries and supersymmetries is reviewed.

44585 **Experimental studies of the photon decays of giant resonances.** Nathan, A.M. (Nuclear Physics Lab./Dept. of Physics, 23 Stadium Drive, Champaign, IL 61820). pp 385-396 of Nuclear structure, reactions and symmetries. Meyer, R.A.; Paar, V. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-8606130—).

From International conference on nuclear structure, reactions, and symmetries; Dubrovnik, Yugoslavia (5 Jun 1986).

A review is given of the existing inelastic photon scattering data. These data are discussed in terms of models for the coupling of the giant dipole resonance (GDR) to surface vibrations. The sensitivity of these experiments to the underlying nuclear structure is emphasized.

6540 Radiation And Shielding Physics

REFER ALSO TO CITATION(S) 43042, 43043, 43124, 43300, 43301, 43302, 44607, 44735

44586 **(BHR—36) On the interaction between gamma-quanta and matter.** Oelgaard, P.L. (Danmarks Tekniske Hoejskole, Lyngby. Afdelingen for Elektrofysik). Nov 1986. 22p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87752411.

Various formulas concerning the interaction between gamma-quanta and matter have been derived. By use of these formulas numerical computations have been performed, and the results are presented in the form of curves. The topics considered include: Differential Compton cross section. Total Compton cross section. Angular distribution functions for Compton scattering. Energy distribution of Compton scattered quanta. Average energy of Compton scattered quanta. Average value of the cosine of the scattering angle. Photoelectric cross section.

44587 **(JAERI-M—87-022) Vectorization of Monte Carlo code MCNP.** Kurita, Yutaka; Suganuma, Masayuki; Higuchi, Kenji; Asai, Kiyoshi. (Japan Atomic Energy Research Inst., Tokyo). Feb 1987. 43p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. File Number DE87752979.

Continuous energy Monte Carlo code MCNP, which is used to analyze the three dimensional transport for neutron and/or photon, has been vectorized on the FACOM VP-100 vector processor. Vectorization has been done by using independent behavior of particles, and the event bank method has been applied to control multiple particles' random walks. In vectorization of MCNP code, there are two problems. One is a large overhead introduced by the program modifications for vectorization. Another is a lowering of vector processing efficiency, since parallelism decreases with time due to the death of the particles. In order to reduce the overhead introduced by the program modifications, processing parts for exceptional events have been isolated from the DO loops. A successive sampling method for source particles has been applied to improve the efficiency of vector processing. The performance ratio of the vectorized version in the vector mode on the FACOM VP-100 to the original one in the scalar mode is 1.3. In this report, we describe sample input data, summary of MCNP code, vectorization technique and performance evaluation of the vectorized MCNP code.

44588 (JAERI-M—87-025, pp 14-18) **Neutron emission from (α,n) reaction in nuclear fuel.** Murata, T. (Nippon Atomic Industry Group Co. Ltd., Kawasaki, Kanagawa. Nuclear Research Lab.). Feb 1987. NTIS (US Sales Only), PC A16/MF A01. File Number DE87900676. (NEANDC(J)—123/U; INDC(JPN)—109/L; CONF-8611159—).

From Seminar on nuclear data; Tokai, Japan (26 Nov 1986).

Nuclear fuels emit neutrons originated in spontaneous fission of heavy elements and in (α,n) reactions of light elements contained in the fuel. These neutron emission data are required in the fields of radiation shielding design of various nuclear facilities and non-destructive measurement of nuclear materials concerning with the process control and safeguarding nuclear materials. The requested (α,n) data in these fields are thick target neutron yield and energy spectrum of emitted neutrons. The present status of the experimental data are reviewed briefly. As an example, thick target neutron yield and emitted neutron energy spectrum are calculated for the O-18(α,n)Ne-21 reaction, which is the most significant (α,n) reaction in oxide fuels.

44589 (JAERI-M—87-025, pp 43-47) **Doubly-differential reaction product data for high energy neutrons.** Baba, M. (Tohoku Univ., Sendai, Japan. Dept. of Nuclear Engineering). Feb 1987. NTIS (US Sales Only), PC A16/MF A01. File Number DE87900676. (NEANDC(J)—123/U; INDC(JPN)—109/L; CONF-8611159—).

From Seminar on nuclear data; Tokai, Japan (26 Nov 1986).

A comment is presented on the needs and status of energy-angular doubly-differential data for high energy neutrons in relation with the neutronic calculations and radiation effects assessment for fusion reactor and accelerator-based high energy neutron source.

44590 (JAERI-M—87-025, pp 62-69) **Fast neutron scattering in the energy range between 10 and 40 MeV.** Yamanouti, Y. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Feb 1987. NTIS (US Sales Only), PC A16/MF A01. File Number DE87900676. (NEANDC(J)—123/U; INDC(JPN)—109/L; CONF-8611159—).

From Seminar on nuclear data; Tokai, Japan (26 Nov 1986).

The neutron scattering cross sections in the energy range from 10 to 40 MeV are reviewed. The theoretical analyses in terms of the phenomenological global optical potential and the microscopic optical potentials are disccussed in this report.

44591 (JAERI-M—87-025, pp 112-120) **Comparison of multigroup and pointwise cross sections used in transport calculations.** Hashikura, Hiroyuki; Kondo, Shunsuke. (Tokyo Univ., Tokai, Ibaraki, Japan. Nuclear Engineering Research Lab.). Feb 1987. NTIS (US Sales Only), PC A16/MF A01. File Number DE87900676. (NEANDC(J)—123/U; INDC(JPN)—109/L; CONF-8611159—).

From Seminar on nuclear data; Tokai, Japan (26 Nov 1986).

Neutron transport calculations have been made using the computer codes of discrete ordinate methods. The evaluated nuclear data are necessary to be processed into the multigroup data for these calculations and the energy boundaries are determined in order to reproduce well the original nuclear data. A number of multigroup data libraries such as GICX40, JSD-100 and VITAMIN-C have been made for the neutron transport calculations. There are some uncertainties in the results of the neutron transport calculations. The uncertainties mainly come from (1) error of nuclear data, (2) error of multigroup cross section and (3) numerical error. The results that are calculated by the point Monte Carlo code, MCNP, using pointwise and multigroup cross sections are compared. The discrepancy depends on the use of pointwise or multigroup cross sections. Because the code utilizes pointwise and multigroup data of the reaction cross sections with the same angular and energy distributions of the secondary neutrons. The energy boundaries used for multigroup cross sections are 42, 100 and 171 groups which correspond to those of GICX40, JSD-100 and VITAMIN-C data libraries, respectively.

44592 (JAERI-M—87-025, pp 312-319) **Thermal neutron cross section: transmission experiments and model calculations.** Granada, J.R. (Comision Nacional de Energia Atomica, San Carlos de Bariloche, Argentina. Centro Atomico Bariloche). Feb 1987. NTIS (US Sales Only), PC A16/MF A01. File Number DE87900676. (NEANDC(J)—123/U; INDC(JPN)—109/L; CONF-8611159—).

From Seminar on nuclear data; Tokai, Japan (26 Nov 1986).

A brief description is presented of some activities related to measurement and calculation of thermal neutron cross sections, currently underway at the Neutron Physics Division of Centro Atomico Bariloche. Examples are given of the application of a Synthetic Scattering Law, with special emphasis on the evaluation of quantities of interest for (thermal) reactor-physics calculations. Some

recent transmission measurements at thermal and epithermal neutron energies are also reported.

44593 (JAERI-M—87-025, pp 320-330) **Combined use of coupled-channel, DWBA and Hauser-Feshbach codes for the calculation of neutron inelastic scattering.** Ohsawa, Takaaki. (Kyushu Univ., Fukuoka, Japan. Dept. of Nuclear Engineering). Feb 1987. NTIS (US Sales Only), PC A16/MF A01. File Number DE87900676. (NEANDC(J)—123/U; INDC(JPN)—109/L; CONF-8611159—).

From Seminar on nuclear data; Tokai, Japan (26 Nov 1986).

A method is proposed to calculate the neutron inelastic scattering cross sections for deformed nuclei taking into account both the direct and compound nuclear processes. The inelastic channels were divided into three classes according to the strength of coupling to the entrance channel. The coupled-channel, DWBA and Hauser-Feshbach methods were combined for use in the calculations for the three classes of channels. This prescription makes it possible to calculate the cross sections accurately without requiring lengthy computational time.

44594 (JAERI-M—87-025, pp 337-346) **Program PEGASUS, a precompound and multi-step evaporation theory code for neutron threshold cross section calculation.** Iijima, Shungo; Sugi, Teruo; Nakagawa, Tsuneo; Nishigori, Takeo. (Nippon Atomic Industry Group Co. Ltd., Tokyo). Feb 1987. NTIS (US Sales Only), PC A16/MF A01. File Number DE87900676. (NEANDC(J)—123/U; INDC(JPN)—109/L; CONF-8611159—).

From Seminar on nuclear data; Tokai, Japan (26 Nov 1986).

PEGASUS, a preequilibrium and evaporation theory code, was developed which calculates 17 neutron reaction cross sections, the particle spectra and the double differential cross sections. The code is suited to a rapid and scoping calculation. Theoretical model and the some results of calculation are presented.

44595 (JAERI-M—87-025, pp 347-360) **Neutron cross sections calculated by GNASH.** Yamamuro, N.; Hida, K. (Nippon Atomic Industry Group Co. Ltd., Kawasaki, Kanagawa. Nuclear Research Lab.). Feb 1987. NTIS (US Sales Only), PC A16/MF A01. File Number DE87900676. (NEANDC(J)—123/U; INDC(JPN)—109/L; CONF-8611159—).

From Seminar on nuclear data; Tokai, Japan (26 Nov 1986).

Computer codes GNASH and CASTHY have been used for the neutron cross section calculations. The revised items for GNASH and the method of evaluation are presented. Calculated good results were obtained for copper neutron cross sections. A method of fission cross section calculation is also given.

44596 **(JAERI-M—87-032) Vectorization of MORSE-DD code.** Higuchi, Kenji; Asai, Kiyoshi; Yamazaki, Takashi. (Japan Atomic Energy Research Inst., Tokyo). Feb 1987. 53p. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. File Number DE87752994.

We have vectorized the multi-group Monte Carlo code MORSE-DD. The Monte Carlo method is very powerful to simulate the motion of particles. However the Monte Carlo codes spend much calculation time, it is required to accelerate the codes by using vector processing. It was known that vectorization of the Monte Carlo codes for treating with the neutron transport problem is very difficult, because each neutron has a different motion and there are many paths in a Monte Carlo step. The Monte Carlo step of MORSE-DD code is completely rewritten by using event bank method. As the result, we have obtained speedup 1.55 times on FACOM VP-100 compared with the original code in scalar mode for problem to analyze neutron behaviour in FNS (Fusion Neutron Source). In this report, the techniques employed for vectorization and the essential problems which prevent from the efficient use of vector processor are described.

44597 **(LA—11030-PR) Radiation transport: Progress report, July 1, 1986-September 30, 1986.** O'Dell, R.D.; Nagy, A. (Los Alamos National Lab., NM (USA)). Aug 1987. Contract W-7405-ENG-36. 56p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87012333.

Research and development progress in radiation transport by the Los Alamos National Laboratory's Group X-6 for the fourth quarter of FY 86 is reported. Included are unclassified tasks in the areas of Monte Carlo Radiation Transport, Cross Sections and Physics, and Deterministic Radiation Transport.

44598 **(N—87-22958) NBS calibration services users guide, 1986-1988 edition.** Uriano, G.A.; Garner, E.L.; Kirby, R.K.; Reed, W.P. (National Bureau of Standards, Washington, DC (USA)). Jul 1986. 205p. (NBS-SP—250). NTIS, PC A10/MF A01.

The National Bureau of Standards (NBS) Calibration Services Users Guide provides detailed descriptions of currently available NBS calibration services, measurement assurance programs, and special test services. The following measurement areas are covered: (1) dimensional, (2) mechanical including flow, acoustic, and ultrasonic, (3) thermodynamic, (4) optical radiation, (5) ionizing radiation, and (6) electromagnetic including dc, ac, RF, and microwave. A separate Fee Schedule is issued every six months which provides current prices for the services offered, updates on points-of-contact, and information on measurement seminars.

44599 **(NBSIR—86-3429) Transport of electrons and associated bremsstrahlung through a composite aluminum-lead shield, with applications to spacecraft shielding.** Barnea, G.; Seltzer, S.M.; Berger, M.J. (National Bureau of Standards, Washington, DC (USA). Center for Radiation Research). Jul 1986. Contract AI05-86ER60390. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013946.

Monte Carlo calculations have been made of the stopping of electrons and the penetration of secondary bremsstrahlung through layered aluminum-lead spacecraft walls. The results are presented in terms of the resultant radiation dose to objects inside. Dose values for monoenergetic incident electrons are given as a function of the aluminum/lead thickness ratio. These data, integrated over a few typical Earth-orbit electron spectra, demonstate the substantial reduction in radiation dose that can be achieved by replacing a portion of an aluminum shield with an inner layer of lead. The main results were obtained by applying a complex-geometry code to spherical-shell configurations. It was found that these results could be reasonably well approximated by an alternative and more economical approach, involving the use of slab-geometry transport results.

44600 (ORNL/RSIC—48, pp 69-80) **Gamma dose from volume sources by a simple equation.** Hodgdon, A.D.; De Gangi, N.L. (Yankee Atomic Electric Co., Framingham, MA). Sep 1986. NTIS, PC A08/MF A01. File Number DE87002165. (ANS/SD—86/17).

In Approximate calculational techniques for radiation protection applications (collection of papers presented at the November 1985 American Nuclear Society meeting).

Techniques are provided to adjust and predict dose from a gamma-emitting volume source. A simple equation allows adjustment of a previously calculated or measured dose for variations in detector location. In addition, an equation of broader scope provides an approximate relation between dose and source size, source material, source density, source energy, and detector location. Both equations are based on an adjoint-implicit analytical approach. Comparisons are made with QADUE [1], and DIDOS [2] generated data. Near-in detector doses differed by a factor of two or less. Other detector locations generally provided a 25% agreement.

44601 (ORNL/RSIC—48, pp 81-97) **Approximate methods in gamma-ray skyshine calculations.** Faw, R.E.; Roseberry, M.L.; Shultis, J.K. (Kansas State Univ., Manhattan). Sep 1986. NTIS, PC A08/MF A01. File Number DE87002165. (ANS/SD—86/17).

In Approximate calculational techniques for radiation protection applications (collection of papers presented at the November 1985 American Nuclear Society meeting).

An approximate computational method for gamma-ray skyshine calculations is described. The method is suitable for a source collimated uniformly about the vertical and accounts for uniform overhead concrete shielding above the source. Results of calcula-

tions are compared to measurements as well as results of other calculations.

44602 (ORNL/RSIC—48, pp 109-129) **Simplified methods for estimating gamma exposure fields transmitted through straight rectangular ducts.** Shultis, J.K.; Thompson, K.R.; Faw, R.E. (Kansas State Univ., Manhattan). Sep 1986. NTIS, PC A08/MF A01. File Number DE87002165. (ANS/SD—86/17).

In Approximate calculational techniques for radiation protection applications (collection of papers presented at the November 1985 American Nuclear Society meeting).

Approximate computational models are developed to describe the spatial variation in the radiation field transmitted through a straight reactangular duct obliquely illuminated by monoenergetic gamma photons. These models account for single and multiple scattering from the duct walls and lips as well as for direct penetration by the photons. Results of calculations are compared to results from a recent benchmark duct streaming experiment, and empirical correction factors are obtained which enable the models to predict the transmitted exposure rates to within 20% of the experimental values.

44603 **(UCRL—95895) Boundary-projection acceleration: A new approach to synthetic acceleration of transport calculations.** Adams, M.L.; Martin, W.R. (Lawrence Livermore National Lab., CA (USA)). Jan 1987. Contract W-7405-ENG-48. 25p. (CONF-8705169—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013221.

From Nuclear science and engineering conference; Paris, France (1 May 1987).

We present a new class of synthetic acceleration methods which can be applied to transport calculations regardless of geometry, discretization scheme, or mesh shape. Unlike other synthetic acceleration methods which base their acceleration on P1 equations, these methods use acceleration equations obtained by projecting the transport solution onto a coarse angular mesh only on cell boundaries. We demonstrate, via Fourier analysis of a simple model problem as well as numerical calculations of various problems, that the simplest of these methods are unconditionally stable with spectral radius $\leq c/3$ (c being the scattering ratio), for several different discretization schemes in slab geometry. 28 refs., 4 figs., 3 tabs.

44604 **(UCRL—97182) The role of pre-equilibrium theory in nuclear data evaluation.** Blann, M. (Lawrence Livermore National Lab., CA (USA)). Aug 1987. Contract W-7405-ENG-48. 14p. (CONF-870959—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013791.

From International conference on neutron physics; Kiev, USSR (21 Sep 1987).

We illustrate the utility of preequilibrium plus equilibrium decay models in reproducing neutron and γ-ray spectra for incident nucleons of $\simeq$ 2 to 20 MeV. We discuss models and theories for calculating preequilibrium nucleon angular distributions and the short comings involved. Attention is focussed on special problems in modelling preequliibrium reactions for target nuclei near shell closures, and possible ways to improve the modelling in these regimes by use of shell model levels to generate few quasi-particle state densities. We show preliminary tests of applicability of preequilibrium models to incident nucleon energies up to 1 GeV and for heavy ion induced reactions at energies up to 300 MeV, areas where modern technology is increasingly seeking nuclear data input. 40 refs., 16 figs.

44605 **Recent measurements of coherent transition radiation.** Moran, M.J. (Lawrence Livermore National Lab., CA). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **24/25**: No. 1, 335-338(Apr 1987). (CONF-861114—). Contract W-7405-ENG-48.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

An extended series of experiments has been used to investigate transition radiation in the X-ray spectral region. The X-rays were generated at the Lawrence Livermore National Laboratory electron-positron linear accelerator by 54 MeV electrons traversing multiple thin-foil targets. The measured angular and spectral distributions have shown excellent agreement with calculated predicitions based on a simplified theoretical description of transition radiation. Recently, energy-resolved measurements of X-ray generation by targets consisting of multiple closely-spaced foils has clearly demonstrated the longitudinal coherence of transition radiation. This behavior might lead to a variety of applications such as tuneable narrow-band X-ray sources, measurement of X-ray dielectric constants, or particle beam diagnostics. These issues will be discussed and recent results will be presented.

44606 **Resonance self-shielding corrections for detector foils in fast neutron spectra.** Mo, S.C.; Ott, K.O. (Argonne National Lab., Applied Physics Div., 9700 S. Cass Avenue, Argonne, IL 60439). *Nuclear Science and Engineering;* **95**: No. 3, 214-224(Mar 1987).

Activation measurements in fast neutron spectra, using detector foils in which the neutron mean-free-path in a resonance is small compared to the foil thickness, are revised by detailed space and energy self-shielding corrections. The experimental data are then comparable with the reaction rate density calculations. The self-shielding factors of individual Doppler-broadened resonances have been calculated with the integral transport theory. A multiple collision technique was required to treat resonance scattering inside the foil because of the small mean-free-path. The foil correction factor at each experimental position is obtained by combining the self-shielding factors of individual resonances with the calculated multigroup reaction rates at the foil locations.

6550 Medical Physics

REFER ALSO TO CITATION(S) 43042, 43043, 43300, 43301, 43302, 44198, 44600, 44601, 44602, 44735

44607 (ORNL/RSIC—48, pp 1-14) **Value of some estimations in radiation protection.** Courtney, J.C.; Williams, M.L. (Louisiana State Univ., Baton Rouge). Sep 1986. NTIS, PC A08/MF A01. File Number DE87002165. (ANS/SD—86/17).

In Approximate calculational techniques for radiation protection applications (collection of papers presented at the November 1985 American Nuclear Society meeting).

Many problems in radiation protection require the use of sophisticated techniques for their solution. However, a large class of problems, particularly in the area of operations, can be addressed with suitable accuracy using approximate techniques. Approximate methods and extrapolation of empirical data can serve to scope the magnitude of a variety of problems. In fact, the authors believe that these approaches should be a necessary first step in determining what additional, more sophisticated analyses are required. Elimination of detail allows one the time to make a number of similar calculations varying the parameters to form an envelope of possible solutions. The advent of microcomputers has helped make engineering approximations even more valuable in both radiation shielding and dose projection calculations. Some examples of approximations and a list of useful references are provided in this paper.

44608 **Comparison of microscopic dose with average dose near high energy heavy ions.** Metting, N.F. (Battelle Pacific Northwest Labs., Richland, WA). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **24/25**: No. 2, 1050-1053(Apr 1987). (CONF-861114—). Contract AC06-76RL01830.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Biophysical studies indicate that the mechanisms responsible for radiation effects involve injury to cell substructures much smaller than a cell nucleus. Therefore, in order to understand the molecular mechanisms responsible, it is important to know the amount of dose deposited in the microscopic volumes of interest for a particular biological endpoint. In the case of heavy ion passage through tissue, the local pattern of energy deposition in critical volumes is strongly influenced by the structure of the track. At the Bevalac in Berkeley, a small proportional counter mounted in a large vacuum chamber was used to measure single event energy deposition distri-

butions as a function of the distance radially outward from the primary ion path, for a 1.3 μm diameter site. It was found that the distribution of energy deposited only by delta-rays in the site resembled that of 170 kVp X-rays, and also that the specific energy (microscopic dose) for those sites exceeded the calculated average radial dose by two orders of magnitude at large radial distances.

6560 Condensed Matter Physics

REFER ALSO TO CITATION(S) 43520, 43524, 43525, 43528, 43619, 43620, 43628, 43920, 43921, 44411, 44426, 44438, 44444, 44586

44609 (CEA-CONF—8778) On the replica symmetric Ising spin glasses. De Dominicis, C.; Mottishaw, F. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Fondamentale (IRF)). May 1986. 25p. (CONF-8605207—2). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752220.

From 9. Sitges conference; Sitges, Spain (26 May 1986).

Confronted with the contradiction between mounting evidence for a phase transition in three dimensions with only two states (in zero field) and the necessity for a symmetry breaking a la PARISI when treating an Ising spin glass with a Gaussian bond distribution, we look, as an escape, for possible stable replica symmetric solutions, in the tree approximation, associated with non-Gaussian distributions.

44610 (CONF-870560—2) Microscopic calculations to predict the temperature dependence of the electron transfer rate in the outer sphere reaction Fe/sup 3+/ yields Fe/sup 2+/ at a gold electrode. Halley, J.W.; Hautman, J.; Rahman, A.; Curtiss, L. (Minnesota Univ., Minneapolis (USA). School of Physics and Astronomy; Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 2p. NTIS, PC A02. File Number DE87011423.

From 171. Electrochemical Society meeting; Philadelphia, PA, USA (10 May 1987).

The study of electron transfer processes has always been known to be central to the understanding of electrochemical processes. This work develops a model to calculate the temperature dependence of a well known electron transfer reaction from first principles. The reaction is the ferrous-ferric electron transfer reaction in $HClO_4$ at a gold electrode. In this reaction, the iron is aquo-coordinated, which simplifies the modeling problem.

44611 (DOE/ER/45282—5) [Strongly interacting fermion systems: Emphasis on heavy fermions: Annual performance report]. (Cornell Univ., Ithaca, NY (USA)). [1987]. Contract FG02-86ER45282. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012460.

The research has been concentrated into two areas: heavy fermions and development of new methods for electronic properties (henceforth referred to as the "electronic structure program"). This first area is going into deep hibernation due to the new interest in the high-T/sub c/ materials; notwithstanding this development, there has been significant progress. On the other hand, in the electronic structure program there has been a period of intense development which is just starting to yield results.

44612 (DOE/ER/45310—2) Dynamical simulation of structural multiplicity in grain boundaries. Majid, I.; Bristowe, P.D. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Materials Science and Engineering). Jun 1987. CONTRACT FG02-87ER45310;FG02-84ER45116. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87012746.

Work on a computer simulation study of a low-energy high-angle boundary structure which is not periodic have been recently reported. This result is of interest since grain boundary structures are usually assumed to have a periodicity corresponding to the appropriate coincidence site lattice (CSL) and many experimental observations of the structure of grain boundaries performed using conventional and high-resolution electron microscopy, electron diffraction and x-ray diffraction appear to support this work. However, this work, using empirical interatomic pair potentials and the relaxation method of molecular statics, have simulated a $\Sigma = 5$ 36.87° (001) twist boundary and found a low energy structure having a larger repeat cell than the CSL and is composed of two different types of structural unit that are randomly distributed in the boundary plane. This result, which has been termed the multiplicity of grain boundary structures, has also been found in the simulation of tilt boundaries. The multiplicity phenomenon is of special interest in twist boundaries since it is used as a structural model to explain the x-ray scattering from a $\Sigma = 5$ boundary in gold. These scattering patterns had previously remained unexplained using stable structures that had simple CSL periodicity. Also, the effect of having a multiple number of low energy structural units coexisting in the grain boundary is of more general interest since it implies that the boundary structures may be quasi-periodic and, in some circumstances, may even result in a roughening of the boundary plane. This paper extends this work by showing, using molecular dynamics, that a multiplicity of structural units can actually nucleate spontaneously in a high-angle grain boundary at finite temperatures.

44613 (JAERI—1304) Studies on surface chemical states of some metals and ceramics bombarded with energetic light-ions. Baba, Yuji. (Japan Atomic Energy Research Inst., Tokyo). Feb 1987. 87p. NTIS (US Sales Only), PC A05/MF A01. File Number DE87752975.

An electron spectroscopy was applied to the investigation of surface chemical state of some metals and ceramics bombarded with energetic light ions. Bombardments of keV-order hydrogen ions on Sc, Ti, V, Y, Zr and Nb induced the XPS core-line chemical shifts to higher binding-energies by 0.2 - 1.4 eV, the appearence of new photopeaks at 3.0 - 5.0 eV below the Fermi level. Although the peak energies are lower by 1 - 3 eV than those calculated for MeH/sub 2/ (Me = metal) by molecular-orbital theory, the peaks are assigned to the metal-H bonds. The chemical shifts induced by bombarding hydrogen-ions were also observed in the X-ray-induced Auger electron spectra (XAES) For Y, Zr and Nb. The hydride layers produced by the ion-implantation are more stable at high temperature than those obtained by thermal synthesis, because of the surface damages which prevent thermal diffusion of hydrogen. In the case of hydrogen-ion bombarded SiC, carbon enriched layer was observed in the near surface region, while the surfaces of Si/sub 3/N/sub 4/ and SiO/sub 2/ became silicon-rich after the bombardments. On the other hand, the bombardments of H/sub 2//sup +/, D/sub 2//sup +/ and He/sup +/-ions on TiC, TiN and TiO/sub 2/ made their surfaces titanium-rich. At high fluences, the X/Ti (X = C, N, O) become constant. The energy dependences of the steady state values of the C/Ti ratios have maximum at 2 - 4 keV/atom of incident ion, while those of the N/Ti and O/Ti ratios decreased with the increase in the ion energies. Incident-energy dependences of the Ti/sup +//X/sup +/ ratios determined by SIMS substantiate that the sputtering is responsible for the surface compositional change of the binary compounds. The surface of TiO/sub 2/ was easily reduced to Ti/sub 2/O/sub 3/ by the H/sub 2//sup +/ and D/sub 2//sup +/, or to TiO by the He/sup +/ and Ar/sup +/-ion bombardments.

44614 (JAERI-M—87-026) Computer simulations of knock-on processes in BCC Ta crystal. Fuse, Motomasa; Taji, Yukichi; Iwata, Tadao. (Japan Atomic Energy Research Inst., Tokyo). Feb 1987. 29p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. File Number DE87752980.

Knock-on processes in bcc tantalum crystal have been investigated by using molecular dynamical program GRAPE. Adopted interatomic potential is the Johnson type which is determined by fitting to experimental values such as elastic constants. The obtained results are summarized as follows. 1) Self-interstitials produced by knock-on process in Ta crystal can be classified into two types; one is [100] and [111] crowdion, and the others are their variations. This point is quite different from the case found in bcc Fe and Mo, in which case only [110] split dumbbell configuration is produced. 2) Calculated distribution of threshold energy for Frenkel-pair production coincides fairly well with the experimental results.

44615 **(LA-UR—87-1755) Theory of Mott insulators.** Brandow, B. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 15p. (CONF-8706146—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87010132.

From NATO advanced workshop on narrow band phenomena; Staverden, Netherlands (1 Jun 1987).

Reviewed is a conceptual picture of Mott insulators, based on strong spin-orbital polarization in unrestricted Hartree-Fock theory with screened intra-atomic parameters. This picture is used to interpret recent work. Implications for the shortcomings of local-density band theory are discussed.

44616 **(SAND—87-0766) A numerical and analytical investigation of Rayleigh-Taylor instability in a solid tungsten plate.** Robinson, A.C.; Swegle, J.W. (Sandia National Labs., Albuquerque, NM (USA)). Jul 1987. Contract AC04-76DP00789. 56p. NTIS, PC A04/MF A01. File Number DE87013593.

The Rayleigh-Taylor instability response of an elastic-plastic tungsten plate is investigated by numerical experiments and an approximate modal analysis. The so-called "minimum amplitude" instability criteria derived from plasticity analyses is shown to be incomplete as a general indicator of instability or stability at very large driving pressures. Model equations are derived which are able to reproduce the basic qualitative features of the observed instability response given by the numerical calculations. 11 refs., 29 figs.

44617 **(SAND—87-1031C) Quantum effects and glasslike behavior in ferroelectric oxides.** Samara, G.A. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1987. Contract AC04-76DP00789. 31p. (CONF-870843—1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012407.

From International conference on electronic structure in phase stability in advanced ceramics; Argonne, IL, USA (17 Aug 1987).

Quantum fluctuations, or zero-point motions, can strongly influence the low temperature response of a system near a structural phase transition. Among the manifestations of quantum fluctuations at ferroelectric phase transitions are different critical exponents, the suppression of the transition temperature, T/sub c/, below its classical value and the development of a quantum paraelectric state. To study these quantum effects as well as the crossover from the classical to the quantum regime, it is necessary to shift T/sub c/ continuously from high to low temperatures. Hydrostatic pressure is an excellent variable for doing so. Results on the mixed oxides K/sub 1-y/Na/sub y/TaO_3 and KTa/sub 1-x/Nb/sub x/O_3 for fixed y and x wil be summarized and discussed to illustrate some of the essential features. Some of these mixed oxides, as well as oxides, exhibit short-range dipolar correlations and glass-like responses. An important current debate is centered around the question of whether or not the low temperature phase of these systems results from the freezing in of short-range order. Results on KTa/sub 1-x/Nb/sub x/O_3 oxides will be discussed and contrasted with other oxides. A novel pressure-induced crossover from normal ferroelectric ordering to dipolar glass behavior in soft TO mode systems with dilute impurities will be discussed, and possible experimental evidence for such a phenomenon will be presented.

44618 **(UCRL—96498) Shock-wave studies using plastic flyers driven by an electric gun for hypervelocity impact on selected materials.** Osher, J.E.; Chau, H.H.; Gathers, G.R.; Lee, R.S.; Pomykal, G.W.; Weingart, R.C. (Lawrence Livermore National Lab., CA (USA)). Jun 1987. Contract W-7405-ENG-48. 6p. (CONF-870753—36). NTIS, PC A02. File Number DE87012631.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

The Lawrence Livermore National Laboratory (LLNL) electric gun is in use for a variety of shock-wave studies using plastic flyer impact on simple materials such as 6061-T6 Al and selected composite combinations at both normal and oblique incidence. The most commonly used flyer is 0.3-mm-thick Kapton at velocities from 1 to 18 mm/μs. The experimentally measured wave shapes and attenuation are compared to code calculations, with particular interest in spall threshold and coupled momentum.

44619 **(UCRL—96521) Chemical equilibrium calculations for the high pressure and temperature dissociation of liquid nitrogen.** Hamilton, D.C.; Ree, F.H. (Lawrence Livermore National Lab., CA (USA)). Jul 1987. Contract W-7405-ENG-48. 5p. (CONF-870753—64). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013788.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

Calculations are reported for the equation-of-state properties of shock-compressed liquid nitrogen. The statistical mechanical, chemical equilibrium calculations, which allow for the simultaneous presence of both the diatomic and monatomic forms of nitrogen, show good agreement with recent dynamic experiments.

44620 **(UCRL—96524) First-principles equations of state for Al, Cu, and Pb in the pressure range 1-10 Mbar.** Moriarty, J.A. (Lawrence Livermore National Lab., CA (USA)). Jul 1987. Contract W-7405-ENG-48. 6p. (CONF-870753—33). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012633.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

Utilizing quantum-mechanical calculations of electronic structure and interatomic forces, first-principles equations of state for the metals Al, Cu, and Pb have been constructed and applied to the analysis of recent shock-impedance-match experiments below 25 Mbar, in which Al served as the reference material.

44621 **(UCRL—97186) Nitrogen at very high pressure.** Nellis, W.J. (Lawrence Livermore National Lab., CA (USA)). Jul 1987. Contract W-7405-ENG-48. 11p. (CONF-870754—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013800.

From 11. international AIRAPT conference; Kiev, USSR (12 Jul 1987).

High-pressure results for nitrogen are reviewed and discussed in terms of phenomena that occur at extreme conditions.

44622 **Prototype fcc-based binary-alloy phase diagrams from tight-binding electronic-structure calculations.** Turchi, P.; Sluiter, M.; de Fontaine, D. (Department of Materials Science and Mineral Engineering, University of California, Berkeley, California 94720). *Physical Review* [*Section*] *B: Condensed Matter;* **36**: No. 6, 3161-3174(15 Aug 1987).

The generalized perturbation method (GPM), previously introduced to investigate the relative stability of simple and complex structures at T = 0 K for transition-metal alloys, is applied to the calculation of fcc-based order-disorder phase diagrams with the use of the cluster-variation method (CVM). Results obtained with the GPM have shown that it was possible to expand the electronic configurational contribution of the total energy, namely the ordering energy, as a sum of concentration-dependent effective cluster interactions, taking the completely disordered state as a reference medium. These interactions are computed from a simple but realistic description of the electronic structure based on the tight-binding approximation appropriate for transition-metal alloys. Calculated energies of mixing and effective interactions are then introduced into the CVM free energy, thereby leading to the calculation of prototype phase diagrams describing phase equilibrium between fcc superstructures of type $L1_0$ and $L1_2$ and the corresponding disordered phase. Electronic parameters are varied systematically and their influence on the topology of the resulting phase diagrams is studied for the first time.

44623 **Surface-plasmon-polariton mode conversion on rough interfaces.** Giergiel, J.; Reed, C.E.; Hemminger, J.C.; Ushioda, S. (Department of Physics, University of California, Irvine, California 92717). *Physical Review* [*Section*] *B: Condensed Matter;* **36**: No. 6, 3052-3058(15 Aug 1987).

We have observed mode conversion in the structure that supports two surface-plasmon polaritons. This mode-conversion phenomenon shows up as the emission from both modes, when either of the modes is excited, and is due to intrinsic roughness of

the interfaces. We present an outline of a first-order (in roughness) Green's-function-based theory that yields a simple expression for the scattering cross section and which is in good agreement with the experimental data. Implications of these results for light-emitting tunnel junctions are discussed.

44624 **Many-body tetrahedral-cluster model for binary and ternary alloys.** Reich, A.; Falicov, L.M. (Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review [Section] B: Condensed Matter;* **36**: No. 6, 3117-3124(15 Aug 1987). Contract AC03-76SF00098.

An exact solution of a four-site tetrahedral crystal model with periodic boundary conditions, the smallest face-centered-cubic crystal, is presented in the case of binary and ternary alloy systems. The model consists of (a) a single s orbital per site with nearest-neighbor-only hopping, (b) a Coulomb repulsion between electrons on the same site, and (c) a single electron per atom. The model, which represents Cu, Ag, Au, and their alloys, shows all the segregational, solutional, and compound-forming tendencies of the real systems. Such characteristics are absent in noninteracting independent-electron approaches. Calculations demonstrate extreme sensitivity to the input one-electron parameters, with minor differences resulting in widely different alloying properties.

44625 **Rietveld refinement of Debye-Scherrer synchrotron X-ray data from Al/sub 2/O/sub 3/.** Thompson, P.; Cox, D.E.; Hastings, J.B. (Brookhaven National Lab., Upton, NY, USA). *Journal of Applied Crystallography;* **20**: No. 2, 79-83(1 Apr 1987). Contract AC02-76CH00016.

The application of the Rietveld refinement technique to synchrotron X-ray data collected from a capillary sample of Al/sub 2/O/sub 3/ in Debye-Scherrer geometry is described. The data we obtained at the Cornell High Energy Synchrotron Source (CHESS) with an Si(111) double-crystal monochromator and a Ge(111) crystal analyzer. Fits to a number of well resolved individual peaks demonstrate that the peak shapes are very well described by the pseudo-Voigt function, which is a simple approximation to the convolution of Gaussian and Lorentzian functions. The variation of the Gaussian and Lorentzian half widths, Γ/sub G/ and Γ/sub L/, with Bragg angle can be approximated quite closely by the functions V $\tan\theta$ and X/$\cos\theta$ which represent the contributions from instrumental resolution and particle-size broadening respectively. Rietveld refinement based on this model yields generally satisfactory results. The refined values of V and X are consistent with the expected vertical divergence ($\simeq$ 0.1 mrad) and the nominal particle size ($\simeq$ 0.3 μm). In particular, the use of capillary specimen virtually eliminates preferred orientation effects, which are highly significant in flat-plate samples of this material.

44626 **Dynamical image charge effects on convoy electron emission from solid surfaces.** Burgdoerfer, J. (Tennessee Univ., Knoxville; Oak Ridge National Lab., TN). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **24/25**: No. 1, 139-142(Apr 1987). (CONF-861114—). Contract AC05-84OR21400.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

We analyze surface effects on the spectrum of convoy electrons emitted from solids in close association with fast highly chargerd ions. Three competing mechanisms have been identified: Deceleration by the surface barrier, acceleration by the repulsive dynamical image force, and energy loss due to surface plasmon generation. The resulting energy shift is significantly reduced compard to the value for the barrier height for a jellium surface. We also give estimates for the probability for nonadiabatic transitions between bound states due to the sudden perturbation by the potential step upon exit.

44627 **Exit charge state dependence of convoy electron production in heavy-ion-solid collisions.** Huelskoetter, H.P.; Burgdoerfer, J.; Sellin, I.A. (Tennessee Univ., Knoxville; Oak Ridge National Lab., TN). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **24/25**: No. 1, 147-152(Apr 1987). (CONF-861114—). Contract AC05-84OR21400.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

The dependence of the yield of convoy electrons emitted near the forward direction in collision involving fast ions and thin solid targets on the emergent projectile charge state is presented and described in terms of primary electron loss events in the solid. The data include a large array of projectiles, projectile energies and charge states, as well as targets ranging in thickness from the nonequilibrium well into the equilibrium thickness region. The description presented in constent with other experiment and theoretical results indicating that the convoy electron production is closely linked to the ELC process observed in binary ion-atom collisions, with the dominant contribution to the convoy yield stemming from excited states of the projectile.

44628 **Microdiffraction with synchrotron radiation.** Ice, G.E. (Oak Ridge National Lab., TN). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **24/25**: No. 1, 397-399(Apr 1987). (CONF-861114—).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Storage ring sources are orders of magnitude brighter than the characteristic line of a rotating anode X-ray tube. This improved brightness allows X-ray diffraction with micron spatial resolution. We report on priliminary microdiffraction experiments using synchrotron radiation. In these experiments, synchrotron radiation beams were passed through specially prepared heavy metal pinholes to achieve probes as small as 10 μm. Both white beam and monochromatic beam techniques are discussed and the ralative merits are compared.

6561 Superconductivity

REFER ALSO TO CITATION(S) 43510, 43526, 43531, 43532, 43547, 43559, 43580, 43598, 43604, 43622, 43624, 43630

44629 **(BNL—40048) Structural phase transformations and high-T/sub c/ superconductivity.** Axe, J.D.; You, H.; Hohlwein, D.; Cox, D.E.; Moss, S.C.; Forster, K.; Hor, P.; Meng, R.L.; Chu, C.W. (Brookhaven National Lab., Upton, NY (USA); Houston Univ., TX (USA). Dept. of Physics). [1987]. Contract AC02-76CH00016. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013308.

This report presents a brief discussion of the connection between high T/sub c/ superconductivity and crystal structure instability. High resolution synchrotron x-ray powder diffraction measurements have been performed on the superconductor La/sub 1.8/Ba/sub 0.2/CuO_4. These measurements show broadening of Bragg peaks, attributed to reduction of the crystal's tetragonal symmetry. This same phenomenon was observed when individual crystals were illuminated by a narrow x-ray beam. The report concludes by recommending further investigations into superconductor crystalline structure. (JDH)

44630 **(FNAL-TM—1465) Flux jumps in a pinch.** Kuchnir, M. (Fermi National Accelerator Lab., Batavia, IL (USA)). 1 Jul 1987. Contract AC02-76CH03000. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013850.

This paper discusses flux jumps, using solid-state physics. The forces on the outermost leptons due to the current flowing through the metal are small compared with the forces in the interatomic environment. The processing of NbTi used in superconducting cables creates defects that pin magnetic flux lines. If one of these pinning sites lets its flux line go, it starts a positive feedback event known as "flux jump". The heat generated can be conducted away before the material goes normal if the superconductor has

large enough surface area, hence the multifilamentary composite wires. (DLC)

6570 Theoretical And Mathematical Physics

REFER ALSO TO CITATION(S) 43758, 43833, 44640, 44791

44631 (AD-A—180640/5/XAB) Calculation of phase shifts in scattering theory. Final report, June 1986-February 1987. Batra, A.; Drew, G.D.; Papaconstantopoulos, D.A. (Naval Research Lab., Washington, DC (USA)). 26 Apr 1987. 169p. (NRL-MR—5944). NTIS, PC A08/MF A01.

Quantum mechanical calculations are presented for the scattering phase shifts of 53 elements in the periodic table. The results of these calculations are presented both as table and as graphs.

44632 (AD-A—180876/5/XAB) Relaxation in systems with exponential or Gaussian distributions of activation energies. Macdonald, J.R. (North Carolina Univ., Chapel Hill (USA). Dept. of Physics and Astronomy). 15 Jan 1987. 15p. NTIS, PC A02/MF A01.

Pub. in Jnl. of Applied Physics, Vol. 61, No. 2, 700-713(15 Jan 1987).

New expressions are presented, simplified, and discussed for the small-signal-frequency response of systems involving distributions of activation energies with either exponential or Gaussian probability densities. The results involve the possibility of separate but related thermal activation of energy storage and energy loss processes, and apply to the response of both dielectric and conductive systems. Response with a Gaussian distribution of activation energies (GDAE) may be either symmetric or asymmetric in log frequency, and typical GDAE responses are compared with those associated with several exponential distributions of activation energy (EDAE) models, using complex nonlinear least squares fitting. The GDAE model does not lead to the frequently observed fractional exponent power-law response in time or frequency as does the EDAE; thus, the GDAE cannot fit any EDAE response well which involves an appreciable range of such behavior, but is found that, conversely, the general EDAE model can often fit a GDAE response very well over a wide frequency range. Recent (KBr)0.5(KCN)0.5 dielectric data covering a range from T=13.7 to 34.7K are analyzed and the GDAE is found to yield the best overall fits. The present analysis suggests an alternative to the earlier results and suggestions that the width of the probability-density distribution increases with decreasing temperature and that the activation energies or barrier heights themselves depend linearly on temperature.

44633 (AD-A—180888/0/XAB) Analysis of a singular hyperbolic system of conservation laws. Isaacson, E.L.; Temple, J.B. (Wisconsin Univ., Madison (USA). Mathematics Research Center). 1986. 13p. NTIS, PC A02/MF A01.

Pub. in Jnl. of Differential Equations, 250-268(1986).

The Riemann and Cauchy problems are solved globally for a singular system of n hyperbolic conservation laws. The system, which arises in the study of oil-reservoir simulation, has only two wave speeds, and these coincide on a surface of codimension one in state space. The analysis uses the random-choice method of Glimm.

44634 (AD-A—180939/1/XAB) Factored-matrix representation of distributed fast transforms. Master's thesis. Bainbridge, R.L. (Naval Postgraduate School, Monterey, CA (USA)). Mar 1987. 143p. NTIS, PC A07/MF A01.

Parallel implementations of Fast Fourier Transforms (FFTs) and other fast transforms are represented using factored, partitioned matrices. The factored matrix description of a distributed FFT is introduced using a decimation in time (DIT) FFT algorithm suitable for implementation on a distributed-signal processor. The heart of the matrix representation of distributed fast transforms is the use of permutations of an NxN identity matrix to describe the required interprocessor data transfers on the Butterfly Network. The properties of these transfer matrices and the resulting output ordering are discussed in detail. The factored matrix representation is then used to show that the Fast Hartley Transform (FHT) and the Walsh Hadamard Transform (WHT) are supported by the Butterfly Network.

44635 (DOE/ET/53088—281) Area as a devil's staircase in twist maps. Chen, Q. (Texas Univ., Austin (USA). Inst. for Fusion Studies). May 1987. Contract FG05-80ET53088. 16p. (IFSR—281). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012663.

In area-preserving maps, the area under an invariant set as a function of frequency is a devil's staircase. We show this staircase is the derivative of the average action of the invariant set with respect to frequency. This implies that resonances fill the phase space completely when there are no invariant curves.

44636 (LYCEN—8213) Dirac, Weyl, Majorana, a review. Uschersohn, J. (Lyon-1 Univ., 69 - Villeurbanne (France). Inst. de Physique Nucleaire). May 1982. 16p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87752228.

The Dirac equation and the properties of Dirac matrices are presented and discussed. A large number of representations of the Dirac matrices is identified. Special emphasis is put on aspects rarely treated or neglected in textbooks.

44637 (RRK—87-1) Magnitude-redshift relation in a perturbed Friedmann universe. Sasaki, Misao. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Feb 1987. 32p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87753020.

A general formula for the magnitude-redshift relation in a linearly perturbed Friedmann universe is derived. The formula does not assume any specific gauge condition, but the gauge-invariance of it is explicitly shown. Then the application of the formula to the spatially flat background model is considered and the implications are discussed.

44638 Duality and gaugino condensation in superstring models. Kounnas, C.; Porrati, M. (Lawrence Berkeley Lab., CA, USA; California Univ., Berkeley, USA. Dept. of Physics; California Univ., Los Angeles, USA. Dept. of Physics). *Physics Letters [Section] B;* **191**: No. 1/2, 91-95(4 Jun 1987). Contract AA03-76SF00034.

The issue of gaugino condensation in superstring generated N=1 supergravity models is reconsidered. We show that gaugino condensation related to the breaking of an R-symmetry is consistent with broken supersymmetry, zero cosmological constant and duality transformation. The latter implies the existence of a massless pseudoscalar, related to a non-compact symmetry, which reflects the gauge invariance of the antisymmetric tensor field of superstring theories.

70 FUSION ENERGY

REFER ALSO TO CITATION(S) 44807

7001 Plasma Research

REFER ALSO TO CITATION(S) 43766, 43953, 44260, 44261, 44392, 44393, 44394, 44395, 44396, 44397, 44398, 44399, 44400, 44401, 44402, 44403, 44404, 44405, 44406, 44407, 44408, 44409, 44426, 44445, 44446, 44635, 44711, 44720, 44732, 44780

44639 (AD-A—181129/8/XAB) Transverse Kelvin-Helmholtz instability with parallel electron dynamics and Coulomb collisions. Interim report. Satyanarayana, P.; Lee, Y.C.; Huba, J.D. (Science Applications International Corp., McLean, VA (USA)). 20 May 1987. 32p. NTIS, PC A03/MF A01.

Electron parallel dynamics and Coulomb collisions are included in the analysis of the transverse Kelvin-Helmholtz instability. The electrons are treated kinetically while the ions are treated in the fluid limit. It is shown that, in the collisionless case, for an in homogeneous velocity profile v(x)=v/sub tanh/ (x/L the kelvin-Helmholtz instability is stable for k/sub z//k/sub y/ > v/sub 0/)/ (L omeg/sub lh/)) k u L(1-k y sq rt in the limit w-ky v/sub 0/ >> k/sub e/ x V/sub e/). Here V/sub o/ is the flow velocity, L is the scale length of the velocity shear layer, k/sub z/ v/sub e/k/sub e/ are the parallel and perpendicular wavenumbers, respectively,

omega sub l h = sq. rt.(Omega/sub e/) (Omega/sub i/), and v sube is the compressional energy given to the electrons parallel to B. In the collisional limit, Coulomb collisions are shown to increase the unstable kz domain because they inhibit the electron motion parallel to B. Applications to the high-latitude ionosphere are discussed.

44640 **(CEA-R—5369) One and half dimensional particle in cell EUTERPE code description.** Bonnaud, G. (M87780165). (CEA Centre d'Etudes de Limeil, 94 - Villeneuve-Saint-Georges (France)). 1987. 72p. (In French). NTIS (US Sales Only), PC A04/MF A01.

A 1D 1/2 electromagnetic particle-in-cell named EUTERPE is described. Firstly, the main features of this code are reported. Secondly, stability tests are presented. As a conclusion, the present-day applications of this code in the electromagnetic field-plasma interaction is given.

44641 **(CTH-IEFT/PP—1986-02) Distortion of ion velocity distributions in the presence of ICRH; a semi-analytical analysis.** Andersson, D.; Eriksson, L.G.; Lisak, M.; Core, W.; Hamnen, H.; Hellsten, T. (Chalmers Univ. of Tech., Goeteborg (Sweden). Inst. for Electromagnetic Field Theory and Plasma Physics). 1986. 44p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87752424.

Assuming the distribution function of ions heated by ion cyclotron resonance absorption to be essentially isotropic, analytical and semi-analytical approximations are derived for the distribution function. The result is used to evaluate the weighted velocity space averages of the distribution, which determine the fusion reactivity and the collisional power transfer to plasma background particles and to study their scaling with RF parameters like absorbed power and perpendicular wave number. The importance of higher order finite Larmor radius effects in suppressing the formation of RF-induced high energy tails is particularly emphasized. Comparisons based on full 2-D numerical calculations show very good agreement with the semi-analytical results.

44642 **(CTH-IEFT/PP—1986-04) Semianalytical analysis of ion velocity distributions in the presence of combined neutral-beam and ICRF-Heating.** Andersson, D.; Eriksson, L.G.; Lisak, M.; Core, W.; Hamnen, H.; Hellsten, T. (Chalmers Univ. of Tech., Goeteborg (Sweden). Inst. for Electromagnetic Field Theory and Plasma Physics). 1986. 31p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87752425.

The energy clamping scheme with combined neutral-beam and ICRF-heating is considered. Assuming the neutral-beam particles to be injected almost isotropically, an approximate equation is derived for the pitch angle averaged distribution function. Comparison between results obtained from this equation and those of a full 2D numerical calculation, shows good agreement for physically significant quantities, like total absorbed power, power transfer to background plasma particles and fusion reactivities. This indicates that the equation for the averaged distribution function should be useful in situations where time consuming 2D numerical calculations of the distribution function are impractical, e.g. in plasma transport codes.

44643 **(CTH-IEFT/PP—1986-11) Similarity solution of two coupled reaction - diffusion rate equations.** Wilhelmsson, H. (Chalmers Univ. of Tech., Goeteborg (Sweden). Inst. for Electromagnetic Field Theory and Plasma Physics). 1986. 8p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87752428.

A coupled system of nonlinear evolution equations describing the combined effects of diffusion and reactions, e.g. fusion reactions or electron-ion recombinations, is transformed into a system of coupled similarity equations in one, two and three dimensions. A description of the evolution of the coupled system for special though physically relevant situations, e.g. the diffusion of an ignited high density fusion plasma (thermal-thermal reactions) of tritium and deuterium is obtained in terms of a particular similarity solution.

44644 **(CTH-IEFT/PP—1986-12) Evolution of burning fusion plasma density and alpha particle production in approaching ignition.** Wilhelmsson, H. (Chalmers Univ. of Tech., Goeteborg (Sweden). Inst. for Electromagnetic Field Theory and Plasma Physics). 1986. 8p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87752429.

The balance in between particle diffusion, reaction processes and particle injection from external sources of tritium and deuterium in a burning fusion plasma is studied analytically by means of coupled model equations. The diffusion processes are described by scaling terms approximating the associated diffusion operators in the coupled reaction-diffusion equations. From the results obtained for the particle densities the associated expressions describing the alpha particle production are constructed for simultaneous beam-thermal and thermal-thermal reactions.

44645 **(CTH-IEFT/PP—1986-13) Role of alpha particles in magnetically confined fusion plasmas.** Lisak, M.; Wilhelmsson, H. (Chalmers Univ. of Tech., Goeteborg (Sweden). Inst. for Electromagnetic Field Theory and Plasma Physics). 1986. 7p. (CONF-8606186—Summ.). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752430.

From Symposium on the role of alpha particles in magnetically confined fusion plasmas; Goteborg, Sweden (24 Jun 1986).

Recent progress in the confinement of hot plasmas in magnetic fusion experiments throughout the world has intensified interest and research in the physics of D-T burning plasmas especially in the wide range of unresolved theoretical as well as experimental questions associated with the role of alpha particles in such devices. In order to review the state-of-the- art in this field, and to identify new issues and problems for further research, the Symposium on the Role of Alpha Particles in Magnetically Confined Fusion Plasmas was held from 24 to 26 June 1986 at Aspenaesgaarden near Goeteborg, Sweden. About 25 leading experts from nine countries attended the Symposium and gave invited talks. The major part of the programme was devoted to alpha-particle effects in tokamaks but some aspects of open systems were also discussed. The possibilities of obtaining ignition in JET and TFTR as well as physics issues for the compact ignition experiments were considered in particular. A special session was devoted to the diagnostics of alpha particles and other fusion products. In this report are summarised some of the highlights of the symposium.

44646 **(CTH-IEFT/PP—1986-14) Fuliy toroidal ion temperature gradient driven drift modes.** Jarmen, A.; Andersson, P.; Weiland, J. (Chalmers Univ. of Tech., Goeteborg (Sweden). Inst. for Electromagnetic Field Theory and Plasma Physics). 1986. 30p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87752431.

A simple quadratic dispersion relation has been derived for electrostatic ion temperature gradient driven modes completely without expansion in aspect ratio. It has also been shown that these modes experience only the local curvature on the outside of the magnetic surface.

44647 **(DOE/ER/40091—T4) Colorado School of Mines Fusion Gamma Ray Project: Final technical progress report.** Cecil, F.E. (Colorado School of Mines, Golden (USA). Dept. of Physics). 15 May 1987. Contract AC02-83ER40091. 21p. NTIS MF A01; 2; GPO Dep. File Number DE87012034.

The gamma ray branching ratios of the d-d, d-^{3}He, and d-t reactions have been measured at center-of-mass energies between about 50 and 150 keV. These branching ratios are roughly constant over this energy range with values of (1.2 +- 0.3) x 10^{-7}, (4.5 +- 1.2) x 10^{-5}, and (5.4 +- 1.3) x 10^{-5} for the d-d, d-^{3}He, and d-t reactions, respectively. We have investigated the use of these reactions as potential diagnostics of fusion plasmas. We have found that for ^{3}He plasmas with temperatures up to a few keV which are heated by neutral deuterium beams up to about 10 MW that the 16.6 MeV gamma ray from the d-^{3}He reaction provides a basis for the measurement of the total d-^{3}He reaction rate. These findings suggest the applicability of this technique to ICRF heated d-^{3}He plasmas and, probably, to beam and ICRF heated d-t plasmas. We conclude that

the technique is probably not applicable to d-d fusion plasmas due to the small gamma ray branching ratio for this reaction.

44648 **(DOE/ER/52127—20) CTR plasma engineering studies: Annual progress report, 1 December 1986-30 November 1987.** Miley, G.H. (Illinois Univ., Urbana (USA). Fusion Studies Lab.). 1987. Contract FG02-86ER52127. 81p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87012721.

During this year studies have been concluded of alpha instability effects on tandem mirrors and also have nearly completed a major effort on the evaluation of F-θ pumping for RFP reactors. New work has begun on alpha effects, burn control, and ash effects in support of the Tiber project. Each of these subjects is briefly described in the following paper.

44649 **(DOE/ET/53088—284) Nonlinear fluid equations for a low collisionality toroidal plasma.** Kotschenreuther, M. (Texas Univ., Austin (USA). Inst. for Fusion Studies). Jul 1987. Contract FG05-80ET53088. 43p. (IFSR—284). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013006.

Nonlinear fluid equations are rigorously derived to describe resonant resistive perturbations localized near a rational surface in a torus, including neoclassical dissipative effects such as rotation damping and bootstrap current production which arise when the collisional mean free path exceeds the equilibrium scale length. A systematically ordered analysis with two parallel scales is used, for a low aspect ratio, starting directly from the drift-kinetic equation. The radial mode width is formally taken of order the poloidal gyroradius, and frequencies are taken to be sufficiently rapid that the perturbed poloidal and toroidal ion flows do not necessarily relax to satisfy the neoclassical equilibrium relation. This is realistic for many modes, and leads to some departures from standard neoclassical results. Neoclassical effects for electrons are relatively smaller than for ions so to include both consistently next order ion corrections are also included. For simplicity temperature perturbations are neglected. The new dissipative terms are shown to satisfy a field theoretic generalization of the Onsager symmetries, and the equations satisfy an H theorem.

44650 **(DOE/ET/53088—285) Tearing mode growth in a regime of weak magnetic shear.** Riyopoulos, S.; Hazeltine, R.D. (Texas Univ., Austin (USA). Inst. for Fusion Studies). Jun 1987. Contract FG05-80ET53088. 13p. (IFSR—285). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013007.

The nonlinear growth for the m/n $\geqq$ 2 resistive tearing mode is studied in case when the rational surface $q(r_0) = m/n$ falls in a regime of weak magnetic shear, $q'(r_0) \cong 0$. The island width is determined self-consistently from the nonlinear, zero-helicity component of the perturbed magnetic flux that provides the local shear. It is found that the magnetic perturbation keeps growing exponentially in the nonlinear regime on a hybrid resistive-Alfvenic time scale, while the island width and the vorticity grow on a much slower time scale. Accordingly, much faster release of magnetic energy results for modes growing near minima of hollow q profiles.

44651 **(EUR—10615) Jet joint undertaking. Annual report 1985.** (Commission of the European Communities, Luxembourg). Jun 1986. 108p. (EUR-JET-AR—8). NTIS (US Sales Only), PC A06/MF A01. File Number DE87752208.

After a presentation of the Jet and nuclear fusion, the results of Jet operations in 1985 are given: energy confinement, MHD activity and disruptive instabilities, impurities and radiation losses, plasma evolution, plasma boundary phenomena, control of plasma current, position and shape, RF heating. Technical achievements in 1985 are summarized: vacuum systems, first wall, multi-pellet injection for fuelling and re-fuelling, containment of forces during vertical instabilities, magnet systems, safety systems, power supplies, neutral beam heating, radio-frequency heating, remote handling, tritium handling, control and data acquisition, diagnostic systems are implied.

44652 **(EUR—10616) Jet joint undertaking. Progress report 1985.** (Commission of the European Communities, Luxembourg). Mar 1986. 354p. (EUR-JET-PR—3). NTIS (US Sales Only), PC A16/MF A01. File Number DE87752207.

A brief introduction and some background information relevant to the Report is first provided. Progress on JET during 1984 is overviewed and, with a survey of scientific and technical achievements during 1984, these advances are set in their general context. This summary is specifically cross referenced to reports and articles prepared and presented by JET staff during 1985. The more important of these articles, which are of general interest, are reproduced as appendices to this Report. Certain developments are considered, which might enable additional improvements/modifications of the machine to further improve its overall performance. These improvements are considered to overcome certain limitations encountered generally on Tokmaks, particularly concerned with density limits, with plasma MHD behaviour, with impurities and with plasma transport. Some attention has been devoted to methods of surmounting these limitations and these are detailed in this section. In the Appendices, selected articles prepared by JET authors are reproduced in detail, and provide more details of the activities and achievements made on JET during 1985. In addition, a full list is included of all Articles, Reports and Conference papers published in 1985.

44653 **(EUR-CEA-FC—1271) Diffusion properties of a guiding center plasma in a model electrostatic turbulence.** Pettini, M.; Vulpiani, A.; Misguich, J.H.; Balescu, R.; De Leener, M.; Orban, J. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Dept. de Recherches sur la Fusion Controlee). 1986. 112p. NTIS (US Sales Only), PC A06/MF A01. File Number DE87752359.

Numerical simulations have been performed to calculate the diffusion coefficient of several hundreds of charged particles across a strong magnetic field B, due to a known spectrum of electrostatic fluctuations. The results have been compared with the turbulent diffusion theory proposed by Misguich et al. The equation of motion is solved with a model electrostatic potential. This potential is also the Hamiltonian of this chaotic non-autonomous system: positive Lyapunov exponents are found in qualitative agreement with theoretical predictions. The absolute diffusion coefficients found in two different models exhibit a transition between two scaling regions: a classical scaling at low amplitudes (D — E/sup 2// B/sup 2/), and a Bohm scaling at higher amplitudes (D — E/B), in agreement with the predictions for these models. The value of the diffusion coefficient obtained in the isotropic model shows a satisfactory agreement with the theory. The study of the relative diffusion of initially close particles yields a clear quantitative confirmation of the clump effect and of the validity of the theoretical treatment of such nonlinearities. (26 figs., 20 refs).

44654 **(EUR-CEA-FC—1308) Analytic study of electron heat transfer in ohmic steady-state.** Capes, H. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Dept. de Recherches sur la Fusion Controlee). Oct 1986. 16p. (In French). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752360.

Analytic solutions of heat equation associated to a given conduction coefficient are studied with experimental observations. Parameters alpha and beta of the thermal conduction coefficient can be chosen so as to reproduce the principal experimental characteristics of the electron temperature profile.

44655 **(EUR-CEA-FC—1312) Study of tokamak plasma electron cyclotron emission during electron-wave interaction near the lower hybrid frequency.** Girard, A. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Dept. de Recherches sur la Fusion Controlee). Nov 1986. 218p. (In French). NTIS (US Sales Only), PC A10/MF A01. File Number DE87752361.

The quasilinear theory of wave-particle interaction is presented. Diagnostic possibilities of electron cyclotron emission. To study the cyclotron radiation (whose wavelength is millimeter order), a Michelson type interferometer is used, which allows to select willingly the useful spectral field. The cyclotron radiation allows characterization of a pumping wave: in studying the spectrum part where plasma is optically thin the studied cyclotron emissivity is directly proportional to absorbed power by plasma. Saturation of power absorption by plasma has been observed and studied.

44656 **(GA-A—18855) Electron cyclotron heating using the fundamental extraordinary mode launched from the low field side on DIII-D.** Prater, R.; Ejima, S.; Harvey, R.W.; Hsu, J.Y.; James, R.A.; Matsuda, K.; Lohr, J.; Mayberry, M.J.; Moeller, C.P.; Simonen, T.C. (GA Technologies, Inc., San Diego, CA (USA)). May 1987. Contract AC03-84ER51044;W-7405-ENG-48. 7p. (CONF-870570—21). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012023.

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

Electron Cyclotron Heating experiments on the DIII-D tokamak using outside launch of the extraordinary mode have shown effective bulk heating at the fundamental resonance, in contradiction of the theory of wave propagation. This may be explained by an efficient process of mode conversion from the extraordinary mode to the ordinary mode upon reflection at the vessel wall of waves reflected from the right hand cutoff in the plasma. The resulting heating has the characteristics expected for heating with the ordinary mode.

44657 **(GA-A—18883) Computation of tearing mode stability in toroidal geometry.** Chu, M.S.; Greene, J.M.; Jensen, T.H. (GA Technologies, Inc., San Diego, CA (USA)). Jul 1987. Contract AC03-84ER53158. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013009.

A computer code ADJ is described which implements the tearing mode energy principle δ W/sub T/ numerically for an arbitrary axisymmetric plasma and present results relevant for the sawtooth stability for equilibria in DIII-D - a tokamak with a noncircular corss-section.

44658 **(HIFT—129) Macroscale particle simulation of kinetic Alfven waves.** Tanaka, Motohiko; Sato, Tetsuya; Hasegawa, Akira. (Hiroshima Univ. (Japan). Inst. for Fusion Theory). Nov 1986. 21p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87753009.

The first successful identification of the kinetic Alfven wave is made by means of a macroscale particle simulation. The kinetic Alfven wave eigenmode in a thermally equilibrium plasma is detected by the power spectrum analysis of the simulation data. The perpendicular wavenumber dependences of both the parallel wave phase velocity and the damping increment of an initially loaded kinetic Alfven waves are in excellent agreements with those predicted analytically. As a unique feature of the kinetic Alfven wave, appreciable acceleration (current drive) and heating of the electrons parallel to the ambient magnetic field are observed during the damping of the finite amplitude kinetic Alfven wave.

44659 **(HIFT—130) Analysis of energy confinement of slideaway discharges.** Itoh, S.-I.; Itoh, K.; Fukuyama, A. (Hiroshima Univ. (Japan). Inst. for Fusion Theory). Jan 1987. 27p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87753008.

The anomalous transport of electrons in the slide-away discharges of tokamak plasma is examined. The tail-current operation is analyzed by combining the Fokker-Planck equation and the radial transport equation. The theoretical model is made with inclusion of the correction in the collisionless limit for the thermal diffusivities of both the tail and the bulk electrons. In the slide-away regime, results show the reduction of the one turn voltage, (V/sub 1//sup proportional to / n/sup 0.5/ (n: density)), the increace of the tail component, and the constancy of the central electron temperature. The model recovers the Alcator law in the usual ohmic discharge. This shows the reduction of the anomalous loss even in the presence of the direct tail loss. Comparison with experiments is made. Experimental observation seems to show the further reduction of the loss.

44660 **(HIFT—131) Effect of ion loss on ICRF heating.** Itoh, K.; Itoh, S.-I.; Fukuyama, A. (Hiroshima Univ. (Japan). Inst. for Fusion Theory). Feb 1987. 35p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87753010.

The effect of the spatial loss on the ICRF (ion cyclotron range of frequency) wave heating is studied. A simple model of the energy-dependent loss term is taken into account of the Fokker-Planck equation. The case of the minority ion heating by a fundamental cyclotron resonance is analysed. It is found that the high energy particle loss imposes a limit of the heating power density, above which the enhancement of the heating power does not increase the energy transfer to the bulk particles, i.e., the heating efficiency is deteriorated. This power limit is serious for the loss with strong energy dependence, such as ripple diffusion. Small spatial loss can annihilate the increment of the fusion reaction by tail generation.

44661 **(HIFT—132) Computational study of three-dimensional magnetohydrodynamic equilibria in toroidal helical systems.** Harafuji, Kenji; Hayashi, Takaya; Sato, Tetsuya. (Hiroshima Univ. (Japan). Inst. for Fusion Theory). Mar 1987. 88p. NTIS (US Sales Only), PC A05/MF A01. File Number DE87753007.

Computational methods based on the time-dependent relaxation technique for obtaining finite beta stellarator equilibria with no net current are described. The computation grid is Eulerian corresponding to space-fixed non-orthogonal helical coordinates. The poloidal cross-section, which is composed of rectangular grids, rotates with the same pitch as that of external helical conductors along the toroidal direction. By this choice, it is possible to handle complicated field topologies and to economize the computer memory. Also, numerical convergence is greatly improved compared with that in cylindrical coordinates. The developed code is applied to two typical l = 2 stellarators (Wendelstein VII-A and Heliotron-E).

44662 **(IPPCZ—253) 13th Czechoslovak seminar on plasma physics and technology.** (Ceskoslovenska Akademie Ved, Prague. Ustav Fyziky Plazmatu). Sep 1985. 123p. (In English and Russian). (CONF-8505358—). NTIS (US Sales Only), PC A06/MF A01. File Number DE87702604.

From 13. Czechoslovak seminar on plasma physics and technology; Liblice, Czechoslovakia (13 May 1985).

Of the 32 papers presented at the 13th Czechoslovak Seminar on Plasma Physics and Technology, 20 papers deal with low-temperature plasma and its applications, e.g., in thin film production, plasma chemistry and electric engineering, and with various methods of low-temperature plasma diagnostics. The investigation of hot plasma in tokamaks and stellarators is the topic of 5 papers; the latest experimental results achieved in the Czechoslovak tokamak Castor and the Soviet devices Tuman-2A, FT-1 and L-2 are reported. Five papers are devoted to high-power pulse technology applications, represented by plasma heating studies with Czechoslovak electron accelerator REBEX, the Polish plasma focus experiment PF-20, and high-current accelerators of negative ions developed in the USSR. In the only two theoretical papers, strong Langmuir turbulence and the Alfven current drive are studied. (J.U.).

44663 **(IPPCZ—253, pp 14) Nonlinear plasmas -experimental research.** Guenther, K.; Hess, H.; Radtke, R. (Akademie der Wissenschaften der DDR, Berlin. Zentralinstitut fuer Elektronenphysik). Sep 1985. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702604. (CONF-8505358—).

From 13. Czechoslovak seminar on plasma physics and technology; Liblice, Czechoslovakia (13 May 1985).

44664 **(IPPCZ—253, pp 32) Compression of plasma in front of coaxial gun.** Kravarik, J.; Kubes, P. (Ceske Vysoke Uceni Technicke, Prague, Czechoslovakia. Fakulta Elektrotechnicka). Sep 1985. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702604. (CONF-8505358—).

From 13. Czechoslovak seminar on plasma physics and technology; Liblice, Czechoslovakia (13 May 1985).

44665 (IPPCZ—253, pp 33-41) **Optical investigations of the breakdown phase in the DPF discharge.** Borowiecki, M.; Czekaj, S.; Denus, S.; Koziarkiewicz, W.; Skrzeczanowski, W.; Socha, R.; Tomaszewski, K.; Zadrozny, M. (Instytut Fizyki Plazmy i Laserowej Mikrosyntezy, Warsaw, Poland). Sep 1985. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702604. (CONF-8505358—).

From 13. Czechoslovak seminar on plasma physics and technology; Liblice, Czechoslovakia (13 May 1985).

The influence of the insulator-electrode configuration and of the working gas filling pressure on the time development of early stages of a plasma focus discharge was investigated experimentally in the PF-20 device. The studies were aimed at optimizing the discharge conditions necessary for achieving a maximum neutron yield. The breakdown and the current sheath build-up phases of the discharge were studied by means of fast streak and frame cameras. The results of optical measurements are discussed in detail. The best discharge homogeneity and a very quiet onset of the acceleration phase were achieved by varying the breech geometry, namely by introducing a special edge insert and by reducing substantially the insulator length. (J.U.).

44666 (IPPCZ—253, pp 54-62) **Technique of processing the results of optical measurements on Tuman 2-A and FT-1 tokamaks.** Lashkul, S.I.; Lebedev, A.D. (AN SSSR, Leningrad. Inst. Vysokomolekulyarnykh Soedinenij). Sep 1985. (In Russian). NTIS (US Sales Only), PC A06/MF A01. File Number DE87702604. (CONF-8505358—).

From 13. Czechoslovak seminar on plasma physics and technology; Liblice, Czechoslovakia (13 May 1985).

The emission spectrum of a tokamak plasma was studied in the range of 500 to 3000 A by means of a relatively calibrated monochromator (spectral resolution 4 A). In this range, radiation losses at oxygen and carbon impurity lines prevail. From the intensities of impurity lines measured at the Tuman-2A tokamak, the densities of oxygen and carbon ions and their radial profiles were evaluated. For absolute calibration, a normalization procedure based on the calculated emissivity at resonant transitions was used. The impurity-generated influx of electrons was estimated to be more than 50% of the total influx. In the FT-1 tokamak, ion temperature and plasma rotation velocity were determined from the measured profiles of the O/sup V/ and C/sup III/ lines. A simple theoretical model was used to estimate the error due to determining the local plasma parameters from chord-averaged data. (J.U.).

44667 (IPPCZ—253, pp 99) **Generation of the shock wave in plasma accelerator.** Pichal, J. (Ceske Vysoke Uceni Technicke, Prague, Czechoslovakia. Fakulta Elektrotechnicka). Sep 1985. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702604. (CONF-8505358—).

From 13. Czechoslovak seminar on plasma physics and technology; Liblice, Czechoslovakia (13 May 1985).

44668 (IPPCZ—253, pp 118-122) **Breakdown on the Castor tokamak.** Valovic, M. (Ceskoslovenska Akademie Ved, Prague. Ustav Fyziky Plazmatu). Sep 1985. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702604. (CONF-8505358—).

From 13. Czechoslovak seminar on plasma physics and technology; Liblice, Czechoslovakia (13 May 1985).

It was shown experimentally that during the inductive tokamak breakdown, a strong overthermal plasma potential is generated. Convective losses during the breakdown were also measured. The mechanism of the losses and of the generation of an electrostatic field is discussed.

44669 (IPPCZ—253, pp 123-127) **Dependence of the discharge on the vertical magnetic field in the TM-1-MH tokamak.** Kryska, L.; Magula, P. (Ceskoslovenska Akademie Ved, Prague. Ustav Fyziky Plazmatu). Sep 1985. (In Russian). NTIS (US Sales Only), PC A06/MF A01. File Number DE87702604. (CONF-8505358—).

From 13. Czechoslovak seminar on plasma physics and technology; Liblice, Czechoslovakia (13 May 1985).

A strong dependence of the tokamak regime on the vertical magnetic field strength was found for the TM-1-MH tokamak. The regime changes are accompanied by changes in the loop voltage, hard X-ray radiation intensity, and soft X-ray spectra. At higher vertical magnetic fields the electron distribution becomes anisotropic, more electrons move along the toroidal magnetic field. These electrons easily proceed to the runaway regime when accelerated to energies of up to 0.1-1.0 MeV. The runaway regime start already in the early stages of the tokamak discharge. The electron current carried by runaway electrons can reach some 30% of the total current, although the density of runaway electrons is negligible with respect to that of the plasma. (J.U.).

44670 (IPPCZ—253, pp 128-137) **Results of experiments and numerical calculations of current-free plasma production and heating in the electron cyclotron resonance regime in the L-2 stellarator.** Sarksyan, K.A. (AN SSSR, Moscow. Inst. Obshchej Fiziki). Sep 1985. (In Russian). NTIS (US Sales Only), PC A06/MF A01. File Number DE87702604. (CONF-8505358—).

From 13. Czechoslovak seminar on plasma physics and technology; Liblice, Czechoslovakia (13 May 1985).

HF plasma generation and heating in the L-2 stellarator was studied both experimentally and theoretically. Strong absorption was observed of the extraordinary wave propagating across the plasma column, resulting in an efficient heating of plasma electrons. It can be explained by cyclotron absorption of the wave, providing the plasma density increases slowly during an HF pulse. The possibility is discussed of optimizing heating efficiency under such conditions. The neoclassical character of transport processes in the current-free plasma in the L-2 stellarator is pointed out. After reaching the density saturation limit, the plasma can efficiently be heated with the ordinary wave. (J.U.).

44671 (IPPCZ—253, pp 93-95) **Ultrasoft X-ray source for the calibration of the photoemission-absorber detection systems.** Piffl, V.; Raus, J.; Sunka, P. (Ceskoslovenska Akademie Ved, Prague. Ustav Fyziky Plazmatu). Sep 1985. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702604. (CONF-8505358—).

From 13. Czechoslovak seminar on plasma physics and technology; Liblice, Czechoslovakia (13 May 1985).

The X-ray tube proposed earlier by Henke was chosen as the radiation source for in-situ calibration of soft X-ray detection systems used for electron distribution measurements in the REBEX machine. The tube configuration was designed using an electroplating vat; the electrode shapes were slightly changed to respect the space charge effects. The tube with a beryllium anode was operated at a voltage of 1 kV and a current of 30 mA. Its radiation was analyzed using Al vacuum photodiodes with zapon-lacker filters. A radiation intensity of about 10/sup -4/W/sterad with a 10% component of the Be/sub K/ line (109 eV) was found. The thickness of the zapon-lacker filters used was checked with a He-Ne laser interferometer. (J.U.).

44672 (IPPCZ—253, pp 96-98) **Measurements with Langmuir probes at medium pressures.** Tichy, M.; David, P.; Sicha, M. (Karlova Univ., Prague, Czechoslovakia. Fakulta Matematicko-Fyzikalni). Sep 1985. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702604. (CONF-8505358—).

From 13. Czechoslovak seminar on plasma physics and technology; Liblice, Czechoslovakia (13 May 1985).

The reliability is discussed of the Langmuir probe technique in measuring plasma parameters at medium pressures, i.e., at Knudsen numbers of much less than unity. For determining the plasma electron temperature with high precision, almost no corrections are needed in a wide range of Knudsen numbers. On the contrary, for evaluating plasma density, corrections must be introduced for charged particle-neutral collisions in the probe sheath. Experimental results are cross-checked with the results of several theories published earlier, and the best way for correcting the experimental data is suggested. (J.U.).

44673 (IPPCZ—253, pp 15-16) **Analytical approximation of the internal energy of a one-component plasma.** Martisovits, V. (Komenskeho Univ., Bratislava, Czechoslovakia). Sep 1985. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702604. (CONF-8505358—).

From 13. Czechoslovak seminar on plasma physics and technology; Liblice, Czechoslovakia (13 May 1985).

44674 (IPPCZ—253, pp 17-22) **Modelling of transverse-flow CO/sub 2/-N/sub 2/ discharges.** Valentini, H.B. (Akademie der Wissenschaften der DDR, Jena. Physikalisch-Technisches Inst.). Sep 1985. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702604. (CONF-8505358—).

From 13. Czechoslovak seminar on plasma physics and technology; Liblice, Czechoslovakia (13 May 1985).

Using a simplified model of a transverse-flow CO/sub 2/-N/sub 2/ discharge, the electron density, concentration of negative ions, the discharge characteristics and the temperature, pressure and velocity of the gas are calculated and the stability of the discharge is assessed.

44675 (IPPCZ—253, pp 23-27) **Theory of the positive column in a transverse magnetic field.** Valentini, H.B. (Akademie der Wissenschaften der DDR, Jena. Physikalisch-Technisches Inst.). Sep 1985. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702604. (CONF-8505358—).

From 13. Czechoslovak seminar on plasma physics and technology; Liblice, Czechoslovakia (13 May 1985).

The influence of a transverse magnetic field on the phenomena in a positive column is theoretically investigated. Using a simplified model the density profile of the charge carriers and their drift velocity to the wall are calculated. It is shown that both the axial electric field intensity and the electron temperature slightly increase when the transverse magnetic field is increased. For such a column the existence condition is derived.

44676 (IPPCZ—253, pp 100-101) **Monte Carlo simulation of collided plasma ions in outer electric field.** Teplanova, K. (Komenskeho Univ., Bratislava, Czechoslovakia). Sep 1985. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702604. (CONF-8505358—).

From 13. Czechoslovak seminar on plasma physics and technology; Liblice, Czechoslovakia (13 May 1985).

The Monte Carlo method is used to simulate the movement of ions in a cold parent gas and a uniform external electric field. The charge exchange and elastic scattering processes are taken into account. The work is aimed at testing the usefulness of Monte Carlo simulation in systems with inhomogeneous electric fields and thus the trajectories of a large number of ions between several collisions are simulated instead of using the usual way of following a single particle undergoing many collisions. (J.U.).

44677 (IPPCZ—253, pp 67-88) **Dynamics of strong Langmuir turbulence - computer simulations.** Sedlacek, Z.; Jungwirth, K.; Stavinoha, P.; Breizman, B.N. (Ceskoslovenska Akademie Ved, Prague. Ustav Fyziky Plazmatu; AN SSSR, Novosibirsk. Sibirskoe Otdelenie). Sep 1985. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702604. (CONF-8505358—).

From 13. Czechoslovak seminar on plasma physics and technology; Liblice, Czechoslovakia (13 May 1985).

One-dimensional computer simulation of the free-evolving turbulence of Langmuir waves with an initial Gaussian spectral distribution and random phases of Fourier harmonics is reported. The discrete Fourier transformation is applied to the Zakharov set of equations and the resulting equations for up to 512 Fourier harmonics of electric field and ion density perturbations are solved by the Runge-Kutta method. The time dependences of energy densities of plasmons and ion sound waves, spatial profiles of plasmon energy and ion density as well as electric field and density spectra are calculated in each step, as illustrated by many diagrams in the paper. In all the runs performed, the modulation processes are dominant. About 60% of plasmons become trapped in density wells with ion acoustic waves being simultaneously excited. Nonlinear formations such as quasisolitons and cavitons are well seen in a number of plots of temporal evolution of the density and plasmon energy perturbations. (J.U.).

44678 (IPPCZ—253, pp 138-151) **Alfven current drive and plasma impedance dynamics allowing for transport processes.** Sidorov, V.P.; Nekrasov, F.M.; Komoshvili, K.G.; Elfimov, A.G.; Favorskij, A.P.; Tishkin, V.F.; Dmitrieva, M.V. (Institute of Physics and Technology, Sukhumi, USSR; AN SSSR, Moscow. Inst. Prikladnoj Matematiki). Sep 1985. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702604. (CONF-8505358—).

From 13. Czechoslovak seminar on plasma physics and technology; Liblice, Czechoslovakia (13 May 1985).

RF field absorption within the Alfven frequency range ($\Omega < \omega$/sub Hi/) and current drive generation by Alfven waves were studied in a cylindrical plasma column allowing for particle, heat and the magnetic field diffusion processes. To this end, a 1-D numerical code describing the RF field formation, absorption and current drive processes was developed with the plasma parameters evolved self-consistently. The code structure includes electrodynamic and transport problems solved in alternation with a 1 ms order step.

44679 (IPPCZ—253, pp 116-117) **New Czechoslovak tokamak CASTOR.** Badalec, J.; Datlov, J.; Jakubka, K.; Kopecky, V.; Koerbel, S.; Kryska, L.; Magula, P.; Preinhaelter, J.; Stoeckel, J.; Valovic, M. Sep 1985. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702604. (CONF-8505358—).

From 13. Czechoslovak seminar on plasma physics and technology; Liblice, Czechoslovakia (13 May 1985).

A fully reconstructed version of the TM-1-MH tokamak was put into operation under the name of CASTOR at the end of 1984. The main parameters of the reconstructed tokamak are listed and its mechanical design is described in detail. The first experiments with the lower hybrid current drive were planned to start in June 1985. For this purpose, two different types of the phased four-waveguide grill were constructed: one with a variable phase shift between adjacent waveguides and the other, a simpler one, with a fixed phase shift (120 deg). Several important diagnostic methods used in the CASTOR tokamak are mentioned. (J.U.).

44680 (JAERI-M—87-012) **Improvement of energy confinement of neutral beam heated plasma by lower hybrid current drive in JT-60.** Ushigusa, Kenkichi; Imai, Takeshi; Yoshino, Ryuji. (Japan Atomic Energy Research Inst., Tokyo). Feb 1987. 26p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87752983.

Energy and particle confinements in a high power neutral beam heated plasma are improved by a lower hybrid current drive (LHCD) in JT-60. A clear correlation between the improvement of the energy confinement time and the decrease of the plasma internal inductance caused by LHCD is observed. The energy confinement time of the profile-controlled plasma by LHCD is close to the ohmic confinement time and does not degrade with the beam absorption power up to 11 MW.

44681 (JAERI-M—87-028) **Two dimensional neutral transport analysis in tokamak plasma.** Shimizu, Katsuhiro; Azumi, Masafumi. (Japan Atomic Energy Research Inst., Tokyo). Feb 1987. 32p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. File Number DE87752984.

Neutral particle influences the particle and energy balance, and play an important role on sputtering impurity and the charge exchange loss of neutral beam injection. In order to study neutral particle behaviour including the effects of asymmetric source and divertor configuration, the two dimensional neutral transport code has been developed using the Monte-Carlo techniques. This code includes the calculation of the H/sub α/ radiation intensity based on the collisional-radiation model. The particle confinement time of the joule heated plasma in JT-60 tokamak is evaluated by comparing the calculated H/sub α/ radiation intensity with the experimental data. The effect of the equilibrium on the neutral density profile in high-β plasma is also investigated.

44682 **(JAERI-M—87-045) Design study for measurement of neutral hydrogen atom density by laser induced fluorescence method.** Yamauchi, Toshihiko; Ogawa, Hiroaki; Yamada, Reiji; Fukuda, Takeshi. (Japan Atomic Energy Research Inst., Tokyo). Mar 1987. 25p. (In Japanese). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752964.

It is designed to measure the fluorescence light emitted from the transitions 1S - 2P of L/sub α/ line (λ = 1215 A) or 2P - 3S or 2P - 3D of H/sub α/ line (λ = 6563 A), excited by the laser induced fluorescence method. The signal-to-noise ratio (S/N) is evaluated at the measurement in the parameter (n-bar/sub e/ = 10/sup 12/ - 10/sup 14/ cm/sup -3/, T/sub e/ = 10 eV - 1 KeV) of tokamak plasma. The light paths in JFT-2M and JT-60 tokamaks are proposed.

44683 **(JAERI-M—87-054) Spectrograms of the visible region in the JT-60 tokamak (wavelength range from 2210 A to 5250 A).** Akaoka, Nobuo; Kubo, Hirotaka; Sugie, Tatsuo; Sakasai, Akira; Koide, Yoshihiko. (Japan Atomic Energy Research Inst., Tokyo). Mar 1987. 24p. (In Japanese). NTIS (US Sales Only), PC A02/MF A01. File Number DE87753002.

In order to obtain the basically spectroscopic data for the investigation of impurity behavior in JT-60 tokamak, the spectrographic measurement of the visible spectral lines in ohmically heated plasma were performed by 0.5 m Czerny-Turner type spectrometer which covered the wave length range from 2210 A to 5250 A. The low ionized spectral lines of oxygen and carbon up to four times, titanium up to three times, and chromium and nickel up to one times were observed. And also two forbidden lines of highly ionized titanium (Ti XVII 3834.4 A, Ti XIX 2344.6 A) which were useful for the measurement of titanium density, local ion temperature and plasma rotation were identified.

44684 **(LA-UR—87-2102) The Los Alamos solid-deuterium-fiber z pinch: Experiment and theory.** Hammel, J.E.; Scudder, D.W.; Glasser, A.; Lindman, E.; Nebel, R. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 6p. (CONF-8706163—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011760.

From Plasma focus and z pinch workshop; Toledo, Spain (29 Jun 1987).

Experiments in which 250 kA have been passed through a z-pinch column formed from a thin fiber of cryogenic solid deuterium have demonstrated unexpectedly stable behavior. It has been shown that it is possible to maintain a z pinch in near radial equilibrium while it is ohmically heated from 16° K to several hundred eV. These encouraging results have motivated an effort to increase the plasma current to 1 MA and above, giving the potential of producing reactor-relevant plasmas capable of significant thermonuclear burn. Such a megamp experiment has been designed, partially fabricated, and successfully tested with an existing generator. A variety of analytic and numerical tools have been used to study the behavior of these pinches. They have shown that the high density z pinch may be expected to have a pressure profile peaked on axis, which can contribute to stability; that the ionization off the fiber may require a time significant with respect to the duration of the experiment; and that the spatial behavior of these plasmas may frequently be described by simple, elegant analytic solutions.

44685 (N—87-23313, pp vp) **Formation of a double layer leading to the critical velocity phenomenon.** Williams, A.C. May 1987. NTIS, PC A14/MF A01. (CONF-8603207—; NASA-CP—2469; M—560; NAS—1.55:2469).

From Double layers in astrophysics conference; Huntsville, AL, USA (17 Mar 1986).

The formation of a double layer is proposed as the mechanism which produces the critical velocity phenomenon. This hypothesis was examined qualitatively and it was found that the double layer can be a very efficient mechanism for transferring the kinetic energy of the neutral gas into the kinetic energy of electrons which, in turn, will ionize the neutral gas if the critical velocity was reached or exceeded.

44686 **(PPPL—2430) Effects of high power ion Bernstein waves on a tokamak plasma.** Ono, M.; Beiersdorfer, P.; Bell, R.; Bernabei, S.; Cavallo, A.; Chmyga, A.; Cohen, S.; Colestock, P.; Gammel, G.; Greene, G.J. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Apr 1987. Contract AC02-76CH03073. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013211.

Ion Bernstein wave heating (IBWH) has been investigated on PLT with up to 650 kW of rf power coupled to the plasma, exceeding the ohmic power of 550 kW. Plasma antenna loading of 2 Ω has been observed, resulting in 80 to 90% of the rf power being coupled to the plasma. An ion heating efficiency of ΔT/sub i/(0)n/sub e//P/sub rf/ = 6 x 10^{13} eV cm^{-3}/kW, without high energy tail ions, has been observed up to the maximum rf power. The deuterium particle confinement during high power IBWH increases significantly (as much as 300%). Associated with it, a longer injected impurity confinement time, reduced drift wave turbulence activity, frequency shifts of drfit wave turbulence, and development of a large negative edge potential were observed. The energy confinement time, however, shows some degradation from the ohmic value, which can be attributed to the enhanced radiation loss observed during IBWH. The ion heating and energy confinement time are relatively independent of plasma current.

44687 **(PPPL—2432) Operation of a tangential bolometer on the PBX tokamak.** Paul, S.F.; Fonck, R.J.; Schmidt, G.L. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Apr 1987. Contract AC02-76CH03073. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013210.

A compact 15-channel bolometer array that views plasma emission tangentially across the midplane has been installed on the PBX tokamak to supplement a 19-channel poloidal array which views the plasma perpendicular to the toroidal direction. By comparing measurements from these arrays, poloidal asymmetries in the emission profile can be assessed. The detector array consists of 15 discrete 2-mm x 2-mm Thinistors, a mixed semiconductor material whose temperature coefficient of resistance is relatively high. The accumulated heat incident on a detector gives rise to a change in the resistance in each active element. Operated in tandem with an identical blind detector, the resistance in each pair is compared in a Wheatstone bridge circuit. The variation in voltage resulting from the change in resistance is amplified, stored on a CAMAC transient recorder during the plasma discharge, and transferred to a VAX data acquisition computer. The instantaneous power is obtained by digitally smoothing and differentiating the signals in time, with suitable compensation for the cooling of the detector over the course of a plasma discharge. The detectors are "free standing," i.e., they are supported only by their electrical leads. Having no substrate in contact with the detector reduces the response time and increases the time it takes for the detector to dissipate its accumulated heat, reducing the compensation for cooling required in the data analysis. The detectors were absolutely calibrated with a tungsten-halogen filament lamp and were found to vary by +-3%. The irradiance profiles are inverted to reveal the radially resolved emitted power density from the plasma, which is typically in the 0.1 to 0.5 W/cm^3 range.

44688 **(PPPL—2435) Coherent and turbulent fluctuations in TFTR.** McGuire, K.; Arunasalam, V.; Bell, M.G.; Bitter, M.; Blanchard, W.R.; Bretz, N.L.; Budny, R.; Bush, C.E.; Callen, J.D.; Chance, M. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Apr 1987. Contract AC02-76CH03073. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013209.

Classification of the sawteeth observed in the TFTR tokamak has been carried out to highlight the differences between the many types observed. Three types of sawteeth are discussed: "simple," "small," and "compound." During the enhanced confinement discharges on TFTR, sawteeth related to q = 1 are usually not present, but a sawtooth-like event is sometimes observed. β approaches the Troyon limit only at low q/sub cyl/ with a clear reduction of achievable β/sub n/ at high q/sub cyl/. This suggests that a β/sub p/ limit, rather than the Troyon-Gruber limit, applies at high q/sub cyl/ in the enhanced confinement discharges. These discharges also reach the stability boundary for n $\rightarrow \infty$ ideal MHD

ballooning modes. Turbulence measurements in the scrape-off region with Langmuir and magnetic probes show strong edge density turbulence n-tilde/n = 0.3 - 0.5, with weak magnetic turbulence B-tilde/sub θ/B/sub θ/ > 5 x 10^{-6} measured at the wall, but these measurements are very sensitive to local edge conditions.

44689 (PPPL—2436) Characteristics of solid-target charge-exchange analyzers for energetic ion diagnostics on tokamaks. Beiersdorfer, P.; Roquemore, A.L.; Kaita, R. (Princeton Univ., NJ (USA). Plasma Physics Lab.). May 1987. Contract AC02-76CH03073. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013208.

Compact electrostatic charge-exchange analyzers have been constructed for installation in areas of high magnetic fields and restricted access near tokamak fusion devices. The analyzers employed carbon stripping foils, and have been calibrated for proton energies between 1 and 70 keV. They have been successfully used to study charge-exchange losses in auxiliary-heated tokamak plasmas.

44690 (PPPL—2437) Fast current ramp experiments on TFTR. Fredrickson, E.D.; McGuire, K.; Goldston, R.J.; Bell, M.; Grek, B.; Johnson, D.; Morris, A.W.; Stauffer, F.J.; Taylor, G.; Zarnstorff, M.C. (Princeton Univ., NJ (USA). Plasma Physics Lab.). May 1987. Contract AC02-76CH03073. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013207.

Electron heat transport on TFTR and other tokamaks is several orders of magnitude larger than neoclassical calculations would predict. Despite considerable effort, there is still no clear theoretical understanding of this anomalous transport. The electron temperature profile T/sub e/(r), shape has shown a marked consistency on many machines, including TFTR, for a wide range of plasma parameters and heating profiles. This could be an important clue as to the process responsible for this enhanced thermal transport. In this paper 'profile consistency' in TFTR is described and an experiment which uses a fast current ramp to transiently decouple the current density profile J(r), and the T/sub e/(r) profiles is discussed. From this experiment the influence of J(r) on electron temperature profile consistency can be determined.

44691 (PPPL—2439) Formation and maintenance of a tokamak discharge via dc helicity injection. Ono, M.; Greene, G.J.; Darrow, D.; Forest, C.; Park, H.; Stix, T.H. (Princeton Univ., NJ (USA). Plasma Physics Lab.). May 1987. Contract AC02-76CH03073. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013205.

Formation and maintenance of a tokamak discharge utilizing helicity injection via a dc low-energy electron beam has been observed in the Current Drive Experiment (CDX). As the plasma current increases, the discharge changes from a configuration dictated by the externally imposed vacuum poloidal fields into a steady-state configuration dominated by the self-generated poloidal field. This configuration was maintained for 60 msec (the time limited by the cathode bias supply), equivalent to more than 400 resistive decay periods. Viewed tangentially, the plasma spontaneously evolves into a circular shape. Measurement of the poloidal magnetic field reveals a considerably peaked current profile, indicating strong radially inward current pinching. The measured q-profile has a typical value of 10 at the plasma edge and reaches a minimum of 4 at the magnetic axis. The line-averaged density profile is also highly peaked, reaching anti n/sub e/ = 2 x 10^{13} cm^{-3} for the central chord. Measurements of plasma conductivity indicate that T/sub e/ rises to ~25 eV, while the spectroscopically observed average ion temperature increases from ~1 eV to ~15 eV as the current increases. These results indicate that the current system evolves toward a tokamak configuration even though the current drive is noninductive.

44692 (PPPL—2441) Ion radial transport induced by ICRF waves in tokamaks. Chen, L.; Vaclavik, J.; Hammett, G.W. (Princeton Univ., NJ (USA). Plasma Physics Lab.). May 1987. Contract AC02-76CH03073. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013204.

The wave-induced fluxes of energetic-trapped ions during ICRF heating of tokamak plasmas are calculated using quasilinear equations. A simple single particle model of this transport mechanism is also given. Both a convective flux proportional to k/sub phi/vertical bar E/sub +/vertical bar^2 and a diffusive flux proportional to k/sub phi/^{2}vertical bar E/sub +/vertical bar^2 are found. Here, k/sub phi/ is the toroidal wave number and E/sub +/ is the left-hand polarized wave field. The convective flux may become significant for large k/sub phi/ if the wave spectrum is asymmetric in k/sub phi/. But for the conditions of most previous experiments, these calculations indicate that radial transport driven directly by the ICRF wave is unimportant.

44693 (PPPL—2443) Prospects for alpha particle studies on TFTR. Zweben, S.J. (Princeton Univ., NJ (USA). Plasma Physics Lab.). May 1987. Contract AC02-76CH03073. 22p. (CONF-8606186—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013202.

From Symposium on the role of alpha particles in magnetically confined fusion plasmas; Goteborg, Sweden (24 Jun 1986).

TFTR is expected to produce approximately 5 MW of alpha heating during the D/T Q ≈ 1 phase of operation in 1990. At that point the collective confinement properties and the heating effects of alpha particles become accessible for study for the first time. This paper outlines the potential performance of TFTR with respect to alpha particle production, the diagnostics which will be available for alpha particle measurements, and the physics issues which can be studied both before and during D/T operation.

44694 (PPPL—2444) Gamma ray measurements during deuterium and ^{3}He discharges on TFTR. Cecil, F.E.; Medley, S.S. (Princeton Univ., NJ (USA). Plasma Physics Lab.). May 1987. Contract AC02-76CH03073. 34p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013201.

Gamma ray count rates and energy spectra have been measured in TFTR deuterium plasmas during ohmic heating and during injection of deuterium neutral beams for total neutron source strengths up to 6 x 10^{15} neutrons per second. The gamma ray measurements for the deuterium plasmas are in general agreement with predictions obtained using simplified transport models. The 16.6 MeV fusion gamma ray from the direct capture reaction D(^{3}He,γ)^{5}Li was observed during deuterium neutral beam injection into ^{3}He plasmas for beam powers up to 7 MW. The measured yield of the 16.6 MeV gamma ray is consistent with the predicted yield. The observation of this capture gamma ray establishes the spectroscopy of the fusion gamma rays from the D-^{3}He reactions as a viable diagnostic of total fusion reaction rates and benchmarks the modeling for extension of the technique to D-T plasmas. 21 refs., 12 figs.

44695 (PPPL—2445) Asymptotic stability boundaries of ballooning modes in circular tokamaks. Chen, L.; Bondeson, A.; Chance, M.S. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jun 1987. Contract AC02-76CH03073. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013200.

The model ballooning mode equation of Connor, Hastie, and Taylor for large-aspect-ratio circular tokamaks is analyzed in the limit of large pressure gradient, and corresponding expressions for stability boundaries are derived. In particular, it is found that for a fixed radial wave number, there exists an infinite sequence of unstable bands, and that minimizing over the radial wave numbers leads to asymptotic merging between the neighboring bands.

44696 (PPPL—2453) Damping of electron cyclotron waves in dense plasmas of a compact ignition tokamak. Mazzucato, E.; Fidone, I.; Granata, G. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jun 1987. Contract AC02-76CH03073. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013198.

Absorption of electromagnetic waves by hot and dense plasmas is investigated in the electron cyclotron range of frequency. It is shown that the strong reduction of the damping of the extraordinary mode, caused by finite Larmor radius effects on waves propagating perpendicularly to the magnetic field, becomes insignificant at large values of the parallel component of the refractive index. With an appropriate form of the relativistic dispersion relation

which includes high order Larmor radius terms, heating of dense plasmas in a Compact Ignition Tokamak is investigated. It is shown that by using the extraordinary mode with oblique propagation and frequency of 190 GHz it is possible to bring to thermonuclear ignition a dense ohmic plasma with a toroidal magnetic field of 105 kG and a central density of 1 x 10^{15} cm^{-3}. 11 refs., 11 figs.

44697 **(UCRL—96829) Computer models for kinetic equations of magnetically confined plasmas.** Killeen, J.; Kerbel, G.D.; McCoy, M.G.; Mirin, A.A.; Horowitz, E.J.; Shumaker, D.E. (Lawrence Livermore National Lab., CA (USA)). 1987. Contract W-7405-ENG-48. 29p. (CONF-8704170—1). NTIS, PC A03/MF A01; GPO Dep. File Number DE87011571.

From International conference on plasma physics; Kiev, USSR (6 Apr 1987).

This paper presents four working computer models developed by the computational physics group of the National Magnetic Fusion Energy Computer Center. All of the models employ a kinetic description of plasma species. Three of the models are collisional, i.e., they include the solution of the Fokker-Planck equation in velocity space. The fourth model is collisionless and treats the plasma ions by a fully three-dimensional particle-in-cell method.

44698 **Evaluation of the slowing down tail enhanced, neoclassical alpha particle energy flux.** Catto, P.J. (Science Applications International Corporation, Plasma Research Institute, 1515 Walnut Street, Boulder, Colorado 80302). *Physics of Fluids;* **30**: No. 9, 2740-2744(Sep 1987).

The non-Maxwellian slowing down tail formed by the energetic alpha particles produced in a fusing tokamak is shown to substantially enhance the neoclassical radial energy loss of alphas. The retention of the pitch angle scattering of the energetic tail alphas by the background ions leads to a neoclassical energy flux that can easily become larger than that of the alpha ash. The enhanced flux can also act to prevent the fusion alpha power from being deposited in the background plasma unless the banana width is sufficiently small.

44699 **Convective contributions to local power loss in a bumpy torus.** Hiroe, S.; Haste, G.R. Jr.; Tolliver, J.S.; Quon, B.H.; Connor, K.A.; Goyer, J.R.; Solensten, L. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physics of Fluids;* **30**: No. 9, 2870-2876(Sep 1987). Contract AC05-84OR21400.

Power flow in the ELMO Bumpy Torus [Plasma Physics and Controlled Nuclear Fusion Research, 1974, Tokyo (IAEA, Vienna, 1975), Vol. 2, p. 141; Plasma Phys. 25, 597 (1983)] was investigated by measuring the power received by a limiter. This power was found to be a small fraction of the gyrotron output power (in one case, 13 out of 100 kW). To investigate the reason for the small fraction that appeared on the limiter, power was selectively removed from various cavities, including the cavity containing the limiter. These experiments have demonstrated that the majority of the power is lost locally. Observations of the potential structure demonstrate that asymmetric potential contours are present that can lead to enhanced plasma loss.

44700 **Compact dispersion relations for parametric instabilities of electromagnetic waves in magnetized plasmas.** Cohen, B.I. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Physics of Fluids;* **30**: No. 9, 2676-2680(Sep 1987). Contract W-7405-ENG-48.

The existence of compact dispersion relations for parametric instabilities of coherent electromagnetic waves in magnetized plasmas is addressed here. In general, comprehensive dispersion relations for parametric instabilities in unmagnetized plasmas become more complicated in the presence of an applied time-independent magnetic field. This is demonstrated with a fluid perturbation theory. A compact dispersion relation for parametric instabilities in unmagnetized plasma is heuristically extended here to the case of a magnetized plasma. This dispersion relation gives the correct results in a variety of circumstances of interest in considering electron cyclotron heating applications.

44701 **Neutral particle kinetics in fusion devices.** Tendler, M.; Heifetz, D. (Royal Institute of Technology, Dept. of Plasma Physics and Fusion Research, Stockholm). *Fusion Technology;* **11**: No. 2, 289-310(Mar 1987).

A survey is given of the theory of neutral particle kinetics, including discussions of adaptations of neutronic methods, and some methods that were developed for neutral particle calculations and have no roots in other fields. Topics considered include thermonuclear devices, neutron transport, calculation methods, and plasma kinetics.

44702 **Ion-ion acoustic instability.** Gary, S.P.; Omidi, N. (Los Alamos National Lab., NM, USA; California Univ., Los Angeles, USA. Inst. of Geophysics and Planetary Physics). *Journal of Plasma Physics;* **37**: 45-61(Feb 1987).

The linear theory of ion-acoustic-like instabilities in a homogeneous Vlasov plasma with two ion components, a less dense beam and a more dense core, with a relative drift velocity is considered. Numerical solutions of the full electrostatic dispersion equation are presented, and the properties of the ion-ion acoustic instability are studied in detail.

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REFER ALSO TO CITATION(S) 43240, 43536, 43633, 43761, 43787, 43829, 44651, 44652, 44699, 44760

44703 (ANL/FPP/TM—210, pp 19-23) **3-D transient eddy current fields using integral techniques and characteristic eigenvalues.** Davey, K.R. (Georgia Institute of Technology, Atlanta). Dec 1986. (CONF-8606260—Summ.).

From 2. regional electromagnetic workshop; Argonne, IL, USA (23 Jun 1986).

The three-dimensional eddy current transient field problem is formulated first using the U-V method. This method breaks the vector Helmholtz equation into two scalar Helmholtz equations. Eigenvalues are found by equating the determinant of the identification matrix (the matrix for determining the problem unknowns) to zero. When the initial forcing function is Fourier decomposed into its respective spatial harmonics, it is possible to associate with each Fourier component a unique set of eigenvalues by this technique. The technique is applied to the Felix medium and large cylinders and compared to data. Inclusion of higher order eigenvalues for each modal shape is seen to yield a substantial improvement in the field prediction correlation to data. The effect of these higher order eigenvalues/modes is of specific interest in this paper; the necessity of including the higher order eigenvalues indicates a drawback of this eigenvalue approach.

44704 (ANL/FPP/TM—210, pp 24-37) **Results for Eddy Current Workshop problems 1A and 1B Felix cylinder experiments.** Ostergaard, D.F. (Swanson Analysis Systems, Inc., Elizabeth, PA). Dec 1986. (CONF-8606260—Summ.).

From 2. regional electromagnetic workshop; Argonne, IL, USA (23 Jun 1986).

The commercially available finite element program ANSYS was used to model the magnetic field problems 1A and 1B of the Eddy Current Workshop problem series. The analysis uses a two-dimensional vector magnetic potential formulation. Two elements were investigated for each problem, the STIF55 4-node isoparametric quadrilateral element and the STIF77 8-node isoparametric quadrilateral element. The meshes used in the analyses were identical to those prescribed in the problem statements. The STIF77 runs included additional mid-side nodes.

44705 (ANL/FPP/TM—210, pp 38-46) **International electromagnetic workshop. Problem 2: Infinitely long cylinder in a sinusoidal field.** Morisue, T. (Univ. of Tokushima, Japan). Dec 1986. (CONF-8606260—Summ.).

From 2. regional electromagnetic workshop; Argonne, IL, USA (23 Jun 1986).

In this report, Problem 2 is solved using the magnetic vector potential and integral equation method. The computing process consists of two phases: in Phase 1 the boundary values of the vector potential and its normal derivative are calculated, and in

Phase 2 the magnetic field and eddy current at the specified points are computed using the finite difference method (in the cylinder) and the integral equation method (both inside and outside the cylinder). The results coincide well with the analytical solution.

44706 (ANL/FPP/TM—210, pp 47-61) **Recalculation of Test Program 2 for the international electromagnetic workshops.** Lari, R.J. Dec 1986. (CONF-8606260—Summ.).

From 2. regional electromagnetic workshop; Argonne, IL, USA (23 Jun 1986).

Test Program 2 was calculated using PE2D/sup (1)/ and reported at the Rutherford Appleton Laboratory Workshop on March 27, 1986. It has been recalculated using a closer approximation to the specified mesh. In addition, quadratic elements were used in the specified mesh to compare with the linear element solution. Finally, a finer mesh using both linear and quadratic elements has been calculated. All of these results are reported here.

44707 (ANL/FPP/TM—210, pp 62-73) **Infinitely long cylinder in a sinusoidal field (Problem 2).** Ida, N. (Univ. of Akron, OH). Dec 1986. (CONF-8606260—Summ.).

From 2. regional electromagnetic workshop; Argonne, IL, USA (23 Jun 1986).

The results presented here were obtained with a 2-D (and axisymmetric) eddy current program called EDDYNDT. The program uses the magnetic vector potential formulation and was specifically designed for the calculation of coil impedances in NDT applications. For normal applications, flux densities, forces, eddy current densities and stored and dissipated energies are not calculated. The program required minor modifications to calculated these quantities form the magnetic vector potential. In its present form, program EDDYNDT cannot handle flux normal boundary conditions. To avoid this, half the cylinder was modeled as opposed to the quarter cylinder in the mesh recommended in the problem outline. This increased the number of elements and nodes but did not change their density or location. Both a solution without the cylinder and a solution with the cylinder are presented. The fields presented are calculated at the center of each element. For this reason, the values presented are interpolated between neighboring elements. This creates a problem, particularly at discontinuities where the errors are largest.

44708 (ANL/FPP/TM—210, pp 74-76) **Sphere in uniform magnetic field.** Ida, N. (Univ. of Akron, OH). Dec 1986. (CONF-8606260—Summ.).

From 2. regional electromagnetic workshop; Argonne, IL, USA (23 Jun 1986).

The results presented here were obtained with a 3-D eddy current program called EDDY3D. The program uses the magnetic vector potential formulation and was specifically designed for the calculation of coil impedances in NDT applications. For normal applications, flux densities and eddy current densities are not calculated explicitly but the stored and dissipated energies are calculated. The program required minor modifications to calculate forces, eddy currents and flux densities. The results presented here are partial preliminary. This particular problem has an analytical solution. Those results presented were compared with approximate analytical calculations. The data not presented is omitted because the program needs to be modified to get it in the form necessary. For this reason, the results are presented in a somewhat different format than required. This data and a complete analytical solution will be presented in the future. The field as well as the eddy current densities are calculated as total values rather than as components. In addition, these are found as average values at the center of each element and are interpolated to get the values at the required points.

44709 (ANL/FPP/TM—210, pp 77-92) **3-D eddy current calculation using the magnetic vector potential.** Morisue, T. (Univ. of Tokushima, Japan). Dec 1986. (CONF-8606260—Summ.).

From 2. regional electromagnetic workshop; Argonne, IL, USA (23 Jun 1986).

To formulate the 3-D eddy current problem as a boundary value problem using the magnetic vector potential, the gauge, interface and boundary conditions of the vector potential should first of all be defined clearly. Without them the boundary value problem could not be solved uniquely and accurately. This contribution presents a new method for calculating 3-D eddy current problems, rigorously defining the interface and boundary conditions of the vector potential. The new field equations do not include the gauge condition explicitly and take a form of the diffusion equation. The gauge condition does appear in the interface and boundary conditions. This method yields a unique solution to the eddy current problem.

44710 **(BNL—39879) Laser enhancement of resonance [dtμ,d2e] and [ddμ,d2e] [molecular] formation.** Takahashi, H. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 12p. (CONF-8705146—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE87011295.

From International symposium on muon catalyzed fusion, MCF-87; Leningrad, USSR (26 May 1987).

The enhancement of resonance molecular formation rates of [dtμ,d2e] and [ddμ,d2e] by strong laser irradiation have been studied. The formation rates decrease until the laser intensity reaches the order of 10^8 to 10^9 W/cm², and they increase substantially for the intensity range of 10^{10} W/cm² to 10^{11} W/cm². The [dtμ,d2e] formation rate using the angular frequency laser such as 11.4×10^{13} rad/sec becomes 4×10^{10} l/sec for the laser intensity of 3×10^{10} W/cm². Further increase of laser intensity reduces the formation rate due to the mismatch of the resonance condition. The formation rate is very sensitive to the frequency of the laser and the formation rate of [ddμ,d2e] becomes comparable with one of [dtμ,d2e] for the cases of $w = 22.8 \times 10^{13}$ rad/sec. For the case of dt initial molecule, there is the possibility of enhancing the formation rate by exciting the vibrational motion by laser field.

44711 **(CONF-870570—11) Resonant loop antenna design with a 2-D steady state analysis.** Chen, G.I.; Ryan, P.M.; Hoffman, D.J.; Baity, F.W.; Swain, D.W.; Whealton, J.H. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 4p. NTIS, PC A02. File Number DE87010015.

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

Evaluation of resonant loop antenna designs for ICRF heating of plasmas requires information concerning the electrical characteristics of the structure. Our 2-D steady state model described herein provides us with current strap inductance and capacitance, surface current distributions, and flux linkage to the plasma. These are used to determine the current and voltage requirements, ohmic dissipation, frequency limits and matching requirements, maximum electric fields, and plasma loading in order to compare antenna designs.

44712 **(CONF-8704118—5-Vugraphs) Alternate configuration.** Lousteau, D.C. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009674.

From TIBER meetings; Livermore, CA, USA (6 Apr 1987).

These vugraphs present some configurations for the Tiber tokamak. The presentation concludes that the number of components exposed to the plasma vacuum should be minimized. (JDH)

44713 **(DOE/ER—0334) Annual report of the Summit Members' Working Group on Controlled Thermonuclear Fusion (Fusin Working Group (FWG)).** (USDOE Office of Energy Research, Washington, DC). Apr 1987. 220p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE87012950.

The Summit Members' Working Group on Controlled Thermonuclear Fusion [Fusion Working Group (FWG)] was established in 1983 in response to the Declaration of the Heads of State and Government at the Versailles Economic Summit meeting of 1982, and in response to the subsequent report of the Working Group in Technology, Growth and Employment (TGE) as endorsed at the Williamsburg Summit meeting, 1983. This document contains the complete written record of each of the three FWG meetings which include the minutes, lists of attendees, agendas, statements, and summary conclusions as well as the full reports of the Technical Working Party. In addition, there is a pertinent exchange of correspondence between FWG members on the role of the Technical

Working Party and a requested background paper on the modalities associated with a possible future ETR project.

44714 **(DOE/ET/51013—223) High throughput electric thruster test stand design.** Guss, W.C.; Myer, R.C.; Post, R.S.; Torti, R.P. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). May 1987. Contract AC02-78ET51013. 10p. (PFC/CP—87-11; CONF-870558—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011038.

From 19. international electric propulsion conference; Colorado Springs, CO, USA (11 May 1987).

The difficulty in developing a test stand for electric (MPD or ion) thrusters involves the following issues: Pumping requirements for high speed and throughput, power supply requirements and associated waste heat removal, erosion of surfaces in contact with the plume and the lack of plume data required for test stand design. The pumping requirements which are dealt with here, have been so difficult to meet that little progress has been made on long pulse issues. A design is proposed using a surface pumping technology, titanium gettering, that has been developed in fusion research laboratories. The getter pumping must be used in a differential pumping scheme to handle the throughput and pumping speed requirements. By starting with short pulse experiments, plume data can be accumulated for the more critical design of the continuous operation test stand for MPD thruster life time tests.

44715 **(EUR—10735) Evaluation of the fusion technology and safety programme of the Joint Research Centre (1980-1985).** Haines, M.; Cabibbo, N.; Crocker, J.G.; Lecomte, M.; Merz, E. (Commission of the European Communities, Ispra (Italy). Joint Research Centre; Commission of the European Communities, Luxembourg). 1986. 139p. NTIS (US Sales Only), PC A07/MF A01. File Number DE87752210.

The Joint Research Centre, Ispra, has been involved in fusion research since 1973. In July 1985 the Commission of European Communities - DG XII, following a policy of systematically evaluating its R and D activities, appointed a panel of external experts to evaluate the fusion technology and safety programme carried out at the Joint Research Centre. This report describes the work of the panel in evaluating the research performed by the JRC within the framework of its 1984-1987 programme. The achievements of the previous programme, 1980-1983, were also taken into consideration. The different research areas covered in the programme, i.e.: reactor studies, breeding blanket technology, structural materials studies, risk assessment and tritium laboratory studies, are described and a draft proposal for the period 1987-1990 presented. The evaluation panel has been asked to assess the following aspects: the scientific and technical achievements of the programme, the contribution of the programme to the development of other Community policies, the role played by the JRC in the European fusion research (including NET) and in international collaborations such as INTOR. From its assessment the evaluation panel has made a series of recommendations for the current programme and for future work.

44716 **(GA-A—18853) Coupling of an ICRF [ion cyclotron range of frequencies] compact loop antenna to H-mode plasmas in DIII-D.** Mayberry, M.J.; Baity, F.W.; Hoffman, D.J.; Luxon, J.L.; Owens, T.L.; Prater, R. (GA Technologies, Inc., San Diego, CA (USA); Oak Ridge National Lab., TN (USA)). May 1987. Contract AC03-84ER51044. 7p. (CONF-870570—20). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012298.

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

Low power coupling tests have been carried out with a prototype ICRF compact loop antenna on the DIII-D tokamak. During neutral-beam-heated L-mode discharges the antenna loading is typically R ≅ 1 - 2Ω for an rf frequency of 32 MHz (B/sub T/ = 21 kG, ω = 2Ω/sub D/(0)). When a transition into the H-mode regime of improved confinement occurs, the loading drops to R ≅ 0.5 - 1.0Ω. During ELMs, transient increases in loading up to several Ohms are observed. The apparent sensitivity of ICRF antenna coupling to changes in the edge plasma profiles associated with the H-mode regime could have important implications for the design of future high power systems.

44717 (IPPCZ—253, pp 63-66) **Controlled REB energy deposition in an inhomogeneous plasma.** Sunka, P.; Babicky, V.; Bohacek, V.; Clupek, M.; Kolacek, K.; Kovac, I.; Krejci, A.; Piffl, V.; Raus, J.; Ripa, M. Sep 1985. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702604. (CONF-8505358—).

From 13. Czechoslovak seminar on plasma physics and technology; Liblice, Czechoslovakia (13 May 1985).

Further investigation of plasma heating by reflected relativistic electron beams in the REBEX machine is reported. The average density of the initial plasma was increased to 5.10/sup 15/ cm/sup -3/. As shown in the paper, varying the initial plasma parameters can shift the region of maximum energy deposition (300 J/m) at will along the interaction chamber. The indispensable role of the reflected electrons in achieving the high energy deposition rates was confirmed experimentally. Vacuum photodiodes and surface barrier soft X-ray detectors were used to obtain information on the distribution of plasma electrons. A hot electron component (10 to 30 keV) was found both in low- and high-density plasma regions. The plasma bulk temperature at the end of beam injection exceeds several times the initial one. (J.U.).

44718 **(JAERI-M—87-009) Review of preliminary additional heating experiments in JT-60 (August-November 1986).** (Japan Atomic Energy Research Inst., Tokyo). Mar 1987. 358p. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. File Number DE87752970.

This is a prompt report on preliminary additional heating experiments in JT-60 from August to November in 1986. Neutral beam heating power was raised up to 20 MW in about a month. Plasma stored energy is about 2 MJ and energy confinement time is 0.1 — 0.12 sec with the maximum heating power. The energy confinement time shows L-mode like deterioration with power, while it has little dependence on electron density. The maximum ion temperature of — 7 keV and electron temperature of 4.5 keV were obtained at relatively low electron density (n-bar/sub e/ = 2 - 3 x 10/sup 19/ m/sup -3/). Lower hybrid wave could efficiently drive plasma current up to 1.7 MA with 1.2 MW LH power. The current drive efficiency is 1 — 1.7 in ohmically heated plasmas and 2 — 2.8 in NB heated plasmas. Futhermore the energy confinement was improved when neutral beam was injected into entirely current driven discharges of 1 MA by LH in contrast to inductively driven target plasmas. Similar improvement in energy confinement was observed during combined heating with NB and ion cyclotron wave.

44719 **(JAERI-M—87-017) Technical evaluation of major candidate blanket systems for fusion power reactor.** Tone, Tatsuzo; Seki, Masahiro; Minato, Akio. (Japan Atomic Energy Research Inst., Tokyo). Mar 1987. 749p. (In Japanese). NTIS (US Sales Only), PC A99/MF A01. File Number DE87752989.

The key functions required for tritium breeding blankets for a fusion power reactor are ; (1) self-sufficient tritium breeding, (2) in-situ tritium recovery and low tritium inventory, (3) high temperature cooling giving a high efficiency of electricity generation and (4) thermo-mechanical reliability and simplified remote maintenance to obtain high plant availability. Blanket performance is substantially governed by materials selection. Major options of structure/breeder/coolant/neutron multiplier materials considered for the present design study are PCA/Li/sub 2/O/H/sub 2/O/Be, Mo-alloy/Li/sub 2/O/He/Be, Mo-alloy/LiAlO/sub 2//He/Be, V-alloy/Li/Li/none, and Mo-alloy/Li/He/none. In addition, remote maintenance of blankets, tritium recovery system, heat transport and energy conversion have been investigated. In this report, technological problems and critical R and D issues for power reactor blanket development are identified and a comparison of major candidate blanket concepts is discussed in terms of the present materials data base, economic performance, prospects for future improvements, and engineering feasibility and difficulties based on the results obtained from individual design studies.

44720 (JAERI-M—87-018) Annual report of the Naka Fusion Research Establishment for the period of April 1, 1985 to March 31, 1986. (Japan Atomic Energy Research Inst., Tokyo). Feb 1987. 299p. NTIS (US Sales Only), PC A13/MF A01. File Number DE87752973.

Research and development activities of the Naka Fusion Research Establishment for the period of April 1985 to March 1986 are described. The JT-60 tokamak machine was completed in April 1985 after a seven-year construction period, and the first plasma operation was achieved on April 8, 1985. Initial experiments with Joule-heated plasmas were performed for three months from April to June 1985 and confirmed tokamak discharges of sufficient plasma current and density as required for additional heating in the divertor configuration. In JFT-2M experiments on beam and ICRF heated plasmas, H-mode discharges with good confinement characteristics were achieved in open divertor configurations. The Doublet III device had been modified into D-III D with a large dee-shaped cross-section. The first plasma was obtained in February 1986. The development of a numerical tokamak code TRITON-II was continued. Plasma-surface interaction studies and vacuum technology development were continued. In the study of plasma heating technology, programmable control of the neutral beam energy was demonstrated in a proto-type injector unit. Negative hydrogen ion beams of 25 keV, 0.1 A were extracted by using multiaperture extraction grid. Research was also carried out on improvements of RF coupling system with emphasis on RF breakdown phenomena in a pill box type ceramic window. In the development of superconducting magnets, generation of a 12T magnetic field was demonstrated by the Test Module Coils. The fabrication of the Demonstration Poloidal Coil was started. Preliminary tritium tests on JAERI's proto-type Pd-diffuser and ceramic electrolysis cell had been successfully carried out in the TSTA at LANL. The design study of the Fusion Experimental Reactor was continued. A wide range of scoping studies was also made to evaluate cost/benefits effects. INTOR design studies were concentrated on tokamak innovations. (J.P.N.).

44721 (JAERI-M—87-021) Development of tokamak reactor systems analysis code 'TORSAC'. Nishio, Satoshi; Tone, Tatsuzo; Kasai, Masao; Nishikawa, Masana. (Japan Atomic Energy Research Inst., Tokyo). Mar 1987. 276p. (In Japanese). NTIS (US Sales Only), PC A13/MF A01. File Number DE87752978.

This report describes Tokamak Reactor Systems Analysis Code "TORSAC" which has been developed in order to assess the impact of the design choices on reactor systems and to improve tokamak designs in wide parameter range. This computer code has following functions. (1) Systematic sensitivity analysis for a set of given design parameters, (2) Cost calculation of a new reactor concept designed automatically as a result of systematic sensitivity analysis.

44722 (JAERI-M—87-025, pp 96-111) **Uncertainty analysis of neutron transport calculation.** Oka, Y.; Furuta, K.; Kondo, S. (Tokyo Univ., Japan). Feb 1987. NTIS (US Sales Only), PC A16/MF A01. File Number DE87900676. (NEANDC(J)—123/U; INDC(JPN)—109/L; CONF-8611159—).

From Seminar on nuclear data; Tokai, Japan (26 Nov 1986).

A cross section sensitivity-uncertainty analysis code, SUSD was developed. The code calculates sensitivity coefficients for one and two-dimensional transport problems based on the first order perturbation theory. Variance and standard deviation of detector responses or design parameters can be obtained using cross section covariance matrix. The code is able to perform sensitivity-uncertainty analysis for secondary neutron angular distribution(SAD) and secondary neutron energy distribution(SED). Covariances of /sup 6/Li and /sup 7/Li neutron cross sections in JENDL-3PR1 were evaluated including SAD and SED. Covariances of Fe and Be were also evaluated. The uncertainty of tritium breeding ratio, fast neutron leakage flux and neutron heating was analysed on four types of blanket concepts for a commercial tokamak fusion reactor. The uncertainty of tritium breeding ratio was less than 6 percent. Contribution from SAD/SED uncertainties are significant for some parameters. Formulas to estimate the errors of numerical solution of the transport equation were derived based on the perturbation theory. This method enables us to deterministically estimate the numerical errors due to iterative solution, spacial discretization and Legendre polynomial expansion of transfer cross-sections. The calculational errors of the tritium breeding ratio and the fast neutron leakage flux of the fusion blankets were analysed.

44723 (JAERI-M—87-029) Transport analysis of OH and NBI heated discharges in JT-60. Hirayama, Toshio; Shimizu, Katsuhiro; Kikuchi, Mitsuru. (Japan Atomic Energy Research Inst., Tokyo). Mar 1987. 35p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87752985.

Transport properties of ohmically and NBI heated plasmas in JT-60 have been analysed by using the one-dimensional tokamak transport code. The very flat density profiles observed in ohmic heating discharges are explained by no inward flow velocity of hydrogen. The saturation of the energy confinement time at high density discharges is due to the increase of the ion energy loss channel and the combination of the neoclassical ion heat diffusivity X/sub i//sup CH/ with multiplication factor of around 6 and the electron heat diffusivity X/sub e/ = 5 x 10/sup 19//n/sub e/q well reproduces experimental data in the density range of n-bar/sub e/ = (2 — 8) x 10/sup 19/ m/sup -3/. The analysis also shows that the electrical conductivity has the Spitzer-type dependence and the trapped electron correction is small. The degradation of the energy confinement under the high power NBI heating is due to the enhancement of electron heat diffusivity. For discharges with 20 MW NBI heating, electron heat diffusivity increases to X/sub e/ = 5 m/sup 2//s at n-bar/sub e/ = 5 x 10/sup 19/ m/sup -3/. By taking into account the beam pressure, it was also shown that stored energies evaluated by the magnetic analysis is consistent with the value evaluated from the transport analysis.

44724 (JAERI-M—87-030) Development of a micro-flow piezoelectric valve for JT-60. Hiratsuka, Hajime; Kawasaki, Kouzou. (Japan Atomic Energy Research Inst., Tokyo). Feb 1987. 25p. (In Japanese). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752981.

A micro-flow piezoelectric gas valve (PEV-LL) for JT-60 has been developed. Remarkables of the valve are summarized as follows: (1) PEV-LL is the same form an appearance small-flow piezoelectric valve (PEV-L); (2) The maximum throughput rate, responce time and helium leakage rate satisfy the designed specifications; (3) Throughput equation for the valve is clarified by comparison with experiment; (4) Reliabilities of PEV-LL under the actual condition during coil power test become clear.

44725 (JAERI-M—87-031) Records of JT-60 motor-generators' installation. (Japan Atomic Energy Research Inst., Tokyo). Mar 1987. 109p. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. File Number DE87753000.

This report describes the installation work of 3 Motor Generators, which were provided for JT-60 Poloidal and Toroidal Field Power Supply Systems, and Plasma Heating System. The construction work took about 5 years from founding of building to installation and rotation test of the MG's. The progress of this work are described in detail referring to the troubles came up during this work. This report is to record the process of the work hoping to be referred to in the succeeding operation and maintenance, and a future construction of the same kind.

44726 (JAERI-M—87-036) Preliminarly analysis for tritium production characteristics of simulated blanket module with lithium oxide breeder irradiated in JMTR OWL-2. Shimakawa, Satoshi; Kawamura, Hiroshi; Nagaoka, Yoshiharu; Saito, Minoru. (Japan Atomic Energy Research Inst., Tokyo). Mar 1987. 55p. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. File Number DE87752969.

The present paper describes the results of neutronics calculation using SRAC code system for the simulated blanket module. The calculations were con-ducted preliminary to irradiation test of the simulated blanket module in the water loop, called OWL-2, of the Japan Materials Testing Reactor (JMTR). The irradiation test has been planned in order to obtain the engineering data for the design of a blanket of a fusion reactor. The simulated blanket module consists of the lithium oxide pebbles packed in a size of 96.3

mm in diameter and 500 mm in length. The summarized results are as follows; 1) The Tritium production rate was about 39 Ci/day. 2) The contribution of the epi-thermal neutron for the trithium production was about 35 percent as much as that of the total neutron. 3) When the packing rate of the lithium oxide was more than 20 %, the increase of the trithium production rate was negligible.

44727 **(JAERI-M—87-038) Scaling of thermonuclear fusion neutron yield on Doublet III tokamak.** Abe, Mitsushi; Nagami, Masayuki; Hirayama, Toshio. (Japan Atomic Energy Research Inst., Tokyo). Mar 1987. 30p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87752967.

Fusion neutron yield during hydrogen neutral beam injection into the deuterium plasmas was examined and compared with neoclassical model, using the Doublet III data obtained in 1983. This provided scalings of thermonuclear fusion neutron yield for discussion on ion energy transport in tokamak devices. Experimental data showed that fusion neutron yield appeared to have a scaling of F proportional to P/sub abs//sup 4/I/sub p//sup 2/ n-bar/sub e//sup -2/ in low-recycling divertor discharges (so called H-mode). The neoclassical theory for ion heat conduction satisfactorily described the scaling of fusion neutron yield. With neutral injection power of P/sub inj/ = 4.6 MW, the Doublet III deuterium plasma yielded thermonuclear neutrons at the rate of 1.2 x 10/sup 13/ (n/s) in low-recycling divertor discharge, which was equivalent to the D/sup +/T/sup +/-plasma with a thermonuclear fusion power multiplication factor Q = 7.8 x 10/sup -5/ or beam driven T/sup +/-plasma with Q = 8.6 x 10/sup -2/. Limiter discharge yielded fewer neutrons.

44728 **(JAERI-M—87-042) Active ion temperature measurement with heating neutral beam.** Miura, Yukitoshi; Matsuda, Toshiaki; Yamamoto, Shin. (Japan Atomic Energy Research Inst., Tokyo). Mar 1987. 15p. (In Japanese). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752991.

When the heating neutral-beam (hydrogen beam) is injected into a deuterium plasma, the density of neutral particles is increased locally. By using this increased neutral particles, the local ion temperature is measured by the active charge-exchange method. The analyzer is the E//B type mass-separated neutral particle energy analyzer and the measured position is about one third outside of the plasma radius. The deuterium energy spectrum is Maxwellian, and the temperature is increased from 350 eV to 900 eV during heating. Since the local hydrogen to deuterium density concentration and the density of the heating neutral-beam as well as the ion temperature can be obtained good S/N ratio, the usefulness of this method during neutral-beam heating is confirmed by this experiment.

44729 **(JAERI-M—87-065) Fusion reactivity enhancement due to ion tail formation by beam and ion cyclotron heating.** Yamagiwa, Mitsuru; Takizuka, Tomonori; Kishimoto, Yasuaki. (Japan Atomic Energy Research Inst., Tokyo). May 1987. 39p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87753018.

Fusion reactivity enhancement due to ion tail formation by NBI (neutral-beam (D/sup 0/) injection) and second harmonic ICH (ion (D/sup +/) cyclotron heating) in a 50:50 D-T plasma is investigated on the basis of local Fokker-Planck calculation. Deformation of the deuteron velocity distribution function is examined analytically and comparison is made with numerical results by using a Fokker-Planck code. The reactivity is given by $\langle\sigma v\rangle = \int d\upsilon \mathrm{vector} f(\upsilon \mathrm{vector}) G(\upsilon)$, where f is the deuteron distribution and G is called 'σv-function' averaged by the isotropic triton distribution. The profile of the integrand typically presents two humps in velocity space for tne beam-induced tail. This results in large reactivity enhancement for high energy beam injection. For the case of the RF(radio frequency)-induced tail, a 'wing' rather than a hump is formed. ICRF (ion cyclotron range of frequency) waves well couple with the beam-induced tail ions and enhance the reactivity, especially when the beam is injected perpendicularly to the magnetic field. The possibility that the combined effects of NBI and second harmonic ICH can exceed the each effect on the reactivity enhancement in the efficiency is indicated.

44730 **(JAERI-M—87-066) Reactivity for DT plasma with beam-induced tail in magnetic confinement system.** Takizuka, Tomonori; Yamagiwa, Mitsuru. (Japan Atomic Energy Research Inst., Tokyo). May 1987. 26p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87753017.

The reactivity for a DT plasma in the magnetic confinement system is presented by useful and simple equations. The reactivity for a DT Maxwellian plasma is given as a function of the ion temperature, and that enhanced by the beam-induced deuteron tail is shown as a function of the ion and electron temperatures, the injection energy, and the beam power density. By using these simple expressions, the fusion power multiplication in a beam-heated plasma is studied on the basis of a local analysis. The value of n/sub e/tau/sub E/ to achieve Q = 1 (n/sub e/: electron density, tau/sub E/: gross energy confinement time, Q: fusion power multiplication factor) becomes smaller by 2.7/T/sup 1.1/ (keV) than that in a Maxwellian plasma without tail component for the plasma temperature of 5 keV < T < 8 keV.

44731 **(JAERI-M—87-069) Evaluation of skyshine calculation method for fusion reactor and application to fusion experimental reactor (FER).** Yamada, Koubun; Seki, Yasushi. (Japan Atomic Energy Research Inst., Tokyo). May 1987. 53p. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. File Number DE87753014.

In the design of the reactor room for a fusion reactor, the cost of the room strongly depends on the thickness of the roof because the area of the roof is generally large. The roof thickness is mostly determined by the requirement to reduce the skyshine dose rate level at the site boundary below the assigned value. Therefore the accurate evaluation of the skyshine dose becomes important for the design of the reactor room. Skyshine dose for a D-T fusion reactor has been evaluated by a number of researchers but the agreement is not so good. In this report, the first collision source is used with two-dimensional S/sub N/ transport method to form DOT3.5-GRTUNCL-DOT3.5 coupled calculation flow. The validity of the methodology was first shown by calculating the skyshine dose from a 14 MeV neutron source and comparing the calculated results with the measured results. This methodology was then used to calculate the skyshine dose for the Fusion Experimental Reactor (FER). The calculated results were compared with those from several other methods to clarify the mutual difference.

44732 **(LA-UR—87-1846) Acceleration to hypervelocities using minimum energy concepts.** Marklin, G. (Los Alamos National Lab., NM (USA)). Jun 1987. Contract W-7405-ENG-36. 4p. (CONF-870631—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011796.

From 8. US symposium on compact toroid research and the 9. US/Japan workshop on compact toroids; College Park, MD, USA (4 Jun 1987).

Experiments have begun at Los Alamos to assess the potential of using spheromaks to transfer energy from large, slow moving metal walls to much smaller, faster moving less massive walls so as to achieve hypervelocities in the 20 to 60 km/s range. A large plate transfers energy to the spheromak during a slow compression. The spheromak then releases this energy in a much shorter time to the small plate, accelerating it to much higher velocity. It has been estimated that velocity gains in excess of 4 (V/sub final/ → 20 km/s) can be achieved in a practical single stage experiment.

44733 **(LBL—23326) Status of inertial fusion.** Keefe, D. (Lawrence Berkeley Lab., CA (USA)). Apr 1987. Contract AC03-76SF00098. 8p. (CONF-870457—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010988.

From Annual meeting of Fusion Power Associates; Pleasanton, CA, USA (8 Apr 1987).

The technology advancement to high-power beams has also given birth to new technologies. That class of Free Electron Lasers that employs rf linacs, synchrotrons, and storage rings - although the use the tools of High Energy Physics (HEP) - was developed well behind the kinetic energy frontier. The induction linac, however, is something of an exception; it was born directly from the needs of the magnetic fusion program, and was not motivated by a high-energy physics application. The heavy-ion approach to inertial

fusion starts with picking from the rich menu of accelerator technologies those that have, ab initio, the essential ingredients needed for a power plant driver: multigap acceleration - which leads to reliability/lifetime; electrical efficiency; repetition rate; and beams that can be reliably focused over a suitably long distance. The report describes the programs underway in Heavy Ion Fusion Accelerator Research as well as listing expected advances in driver, target, and beam quality areas in the inertial fusion power program.

44734 **(ORNL/FEDC—87/3) Elastic-plastic analysis of the toroidal field coil inner leg of the compact ignition tokamak.** Horie, T. (Oak Ridge National Lab., TN (USA)). Jul 1987. Contract AC05-84OR21400. 37p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013377.

Elastic-plastic analyses were made for the inner leg of the Compact Ignition Tokamak toroidal field (TF) coil, which is made of copper-Inconel composite material. From the result of the elastic-plastic analysis, the effective Young's moduli of the inner leg were determined by the analytical equations. These Young's moduli are useful for the three-dimensional, elastic, overall TF coil analysis. Comparison among the results of the baseline design (R = 1.324 m), the bucked pressless design, the 1.527-m major radius design, and the 1.6-m major radius design was also made, based on the elastic-plastic TF coil inner leg analyses.

44735 (ORNL/RSIC—48, pp 131-144) **14-MeV neutron streaming through shield gaps.** Urban, W.T. (Los Alamos National Lab., NM). Sep 1986. NTIS, PC A08/MF A01. File Number DE87002165. (ANS/SD—86/17).

In Approximate calculational techniques for radiation protection applications (collection of papers presented at the November 1985 American Nuclear Society meeting).

Monte Carlo calculations have been performed to determine the neutron streaming through straight and single-bend gaps for three different shield thicknesses. A uniform plane source emitting 14-MeV neutrons with a cosine angular distribution was used in the analyses. The results obtained are discussed in terms of how they might be used in the early stages of a shield design to obtain approximate solutions to design questions. These results have direct implications regarding neutron-streaming problems that will be encountered in the shielding analyses of tokamak fusion reactors which are constructed from pie-shaped shield/vacuum chamber segments.

44736 **(PPPL—2426) Lower hybrid experiments on PLT using grills having various n/sub parallel/ spectral widths.** Stevens, J.E.; Bell, R.; Bernabei, S.; Cavallo, A.; Chu, T.K.; Colestock, P.; Hooke, W.; Hosea, J.; Jobes, F.; Luce, T. (Princeton Univ., NJ (USA). Plasma Physics Lab.). May 1987. Contract AC02-76CH03073. 49p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013212.

Coupling structures for lower hybrid current drive experiments have, until now, been smaller than a free space wavelength and have had a correspondingly broad wave number spectrum. In this paper we report the results of experiments on the PLT tokamak using a 16-waveguide grill (2.2 wavelengths) which produces a very narrow n/sub parallel/ = k/sub parallel/c/ω spectrum. Experimental results from the 16-waveguide grill are compared with results from three other PLT grills with less sharply defined n/sub parallel/ spectra. The current drive figure of merit, I/sub p/n/sub e/R/P/sub rf/ $\cong$0.14 x 10^{14} A cm^{-3} m/W, is $\cong$40% higher for the 16-waveguide coupler than for previously reported experiments on PLT, in spite of the larger "spectral gap." 60 refs.

44737 **(PPPL—2442) Environmental monitoring report for Calendar Year 1986.** Stencel, J.R. (Princeton Univ., NJ (USA). Plasma Physics Lab.). May 1987. Contract AC02-76CH03073. 83p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87013203.

The results of the 1986 environmental monitoring program for the Princeton Plasma Physics Laboratory (PPPL) are presented and discussed. Two of three large tokamak machines, the Princeton Large Torus (PLT) and the Tokamak Fusion Test Reactor (TFTR) were in operation during the year. The Princeton Beta Experiment (PBX) was shut down in December 1985 to undergo major modifications, and will recommence operations in 1987. PLT was shut down in December 1986. In addition, the S-1 Spheromak and the Radio-Frequency Test Facility (RFTF) were operated on a limited basis in 1986. The Environmental Committee became a standing committee of the Executive Safety Board (ESB) and continued to review items of environmental importance. During CY86 no adverse effects to the environment or public resulted from any operational program activities at PPPL, and the Laboratory was in compliance with all applicable federal, state, and local environmental regulations.

44738 **(SAND—87-0172C) Investigations into the design of multi-terawatt magnetic switches.** Harjes, H.C.; Penn, K.J.; Mann, G.A.; Neau, E.L. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-870656—40). NTIS, PC A02. File Number DE87012014.

From 6. Institute of Electrical and Electronic Engineers pulsed power conference; Arlington, VA, USA (29 Jun 1987).

Magnetic switches were successfully used for pulse compression in the CometII pulsed power module to deliver 2.7 MV and 3.7 TW to a 2 Ω matched load. However, the Comet switches suffered interwinding dielectric breakdowns and failed in $<$100 shots. Initial results from experiments on magnetic switch core insulations indicate that the insulation scheme used in the Comet switches was not optimal and better configurations exist. The Comet magnetic switch failures have been duplicated and studied on the Magnetic Switch Test Module (MSTM), a coaxial, 2 Ω PFL driven by a 600 kV Marx generator. The results of these experiments are discussed in detail.

44739 **(SAND—87-0257C) Recording multiple signals on a single waveform recorder.** Boyer, W.B.; Bouchier, F.A.; Mattson, C.R. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 16p. (CONF-870656—30). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011632.

From 6. Institute of Electrical and Electronic Engineers pulsed power conference; Arlington, VA, USA (29 Jun 1987).

The data acquisition system for the PBFA II accelerator is recording up to 3 signals on each of 64 LeCroy 6880 waveform recorders by separating the signals in time. The time separation is done using both the natural delay times in the accelerator and delay cables. Fast switches must be used to gate the signals to the recorder only during the time of interest. Phillips Scientific model 744 Quad Linear Gated Fan-in/Fan-out NIM modules are being used to switch the signals. Several problems with these switches had to be solved. The switches have a dc thermal drift and a nonlinear transfer function. This requires using a programmable function generator to measure and correct for the switch/6880 amplitude transfer function. The switches have a .1Ω output impedance. This produces spurious signals on recorded waveforms due to reflections from small deviations from 50Ω at the 6880 input. This problem was solved using a 5X attenuator at the switch output. Phillips has recently introduced a new model 7145 switch which should solve some of the problems encountered with the 744.

44740 **(SAND—87-0460C) The APEX Pulse Shaping Project for PBFA II [Particle Beam Fusion Accelerator II].** Crow, J.T.; Allshouse, G.O.; Neau, E.L.; Olson, C.L.; Slutz, S.A. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-870656—31). NTIS, PC A02. File Number DE87011857.

From 6. Institute of Electrical and Electronic Engineers pulsed power conference; Arlington, VA, USA (29 Jun 1987).

The APEX Project will develop an ion beam pulse-shaping and target standoff capability for installation on PBFA II. The project includes development of an efficient focusing extraction ion diode and plasma transport channels for ion beam propagation over several meters. The ion beam will have a pulse shape, power and area appropriate for investigating D-T fusion targets designed for pulse-shaped ion beams. Target simulations will determine the pulse shape needed on target. The system, as presently conceived, will use a single diode and transport channel, and a target designed for illumination by a single ion beam.

44741 **(SAND—87-1688C) Behavior of graphites under intense heat loads.** Bohdansky, J.; Croessmann, C.D.; Linke, J. (Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 7p. (CONF-860917—22). NTIS, PC A02. File Number DE87012128.

From 14. SOFT - symposium on fusion technology; Avignon, France (8 Sep 1986).

Today, graphite is used in most tokamak experiments as a first wall material (e.g., limiters, collector plates, amor-tiles) due to its excellent thermal shock resistance, low-Z mass, and high sublimation temperature. On the other hand, due to the high porosity gas absorption can create a severe problem. Besides outgassing, chemical erosion and sublimation can also contribute to impurity introduction into the plasma. In this experiment the behavior of graphitic materials (fine-grain reactor grade graphites, carbon fiber composite materials etc.) has been tested under high heat loads. More emphasis was laid on the following aspects: thermomechanical properties (cracking behavior); thermal erosion behavior (weight loss, surface modifications); outgassing behavior (25 to 1600°C).

44742 **(UCRL—95733) Measurements of diamond turned copper mirrors at glancing incidence.** Kimura, W.D.; Saito, T.T. (Spectra Technology, Inc., Bellevue, WA (USA); Lawrence Livermore National Lab., CA (USA)). Jan 1987. Contract W-7405-ENG-48. 21p. (CONF-870132—13). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011322.

From OE/LASE '87; Los Angeles, CA, USA (11 Jan 1987).

The results of glancing incidence absorptance measurements performed on diamond turned copper mirrors are presented. A photoacoustic calorimetry technique is used in which the output from a low power, chopped cw Nd:YAG laser (1.06 μm) is incident upon the mirror at angles of incidence from 0 to 87°, for both s and p-polarizations. Measurements are obtained as a function of the diamond turning groove orientation with respect to the plane of incidence. Minimum absorptance at high angles of incidence is achieved with s-polarized light and with the grooves aligned parallel to the plane of incidence. The effects on the absorptance of a large scratch at glancing incidence are also described.

44743 **(UCRL—95927) Superconducting magnets for fusion applications.** Henning, C.D. (Lawrence Livermore National Lab., CA (USA)). 2 Jul 1987. Contract W-7405-ENG-48. 12p. (CONF-8706125—4). NTIS, PC A02/MF A01; GPO Dep. File Number DE87011923.

From Conference on advances in cryogenic engineering; St. Charles, IL, USA (14 Jun 1987).

Fusion magnet technology has made spectacular advances in the past decade; to wit, the Mirror Fusion Test Facility and the Large Coil Project. However, further advances are still required for advanced economical fusion reactors. Higher fields to 14 T and radiation-hardened superconductors and insulators will be necessary. Coupled with high rates of nuclear heating and pulsed losses, the next-generation magnets will need still higher current density, better stability and quench protection. Cable-in-conduit conductors coupled with polyimide insulations and better steels seem to be the appropriate path. Neutron fluences up to 10^{19} neutrons/cm^2 in niobium tin are achievable. In the future, other amorphous superconductors could raise these limits further to extend reactor life or decrease the neutron shielding and corresponding reactor size.

44744 **(UCRL—96001) Thermal analysis of the forced cooled conductor for the TF [toroidal field] superconducting coils in the TIBER II ETR design.** Kerns, J.A.; Slack, D.S.; Miller, J.R. (Lawrence Livermore National Lab., CA (USA)). 11 Jun 1987. Contract W-7405-ENG-48. 10p. (CONF-8706125—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011922.

From Conference on advances in cryogenic engineering; St. Charles, IL, USA (14 Jun 1987).

The Tokamak Ignition/Burn Experimental Reactor (TIBER) is being designed to provide nuclear testing capabilities for first wall and blanket design concepts. The baseline design for TIBER II is to provide steady-state nuclear burn capabilities. These objectives must be met using reactor relevant components, such as state-of-the-art current drive schemes coupled with superconducting toroidal field (TF) and poloidal field (PF) coils. The design is also constrained to be cost effective, which forces the machine to be as small as possible. This last constraint limits the nuclear shielding in TIBER. Therefore, the TF coils will have a high nuclear heat load of up to 4.5 kW per coil. The cooling scheme and the thermal analysis for this design are presented.

44745 **(UCRL—96661) Operation of the cryogenic system for the Mirror Fusion Test Facility.** Chronis, W.C.; Slack, D.S. (Lawrence Livermore National Lab., CA (USA); Continuous Electron Beam Accelerator Facility, Newport News, VA (USA)). 9 Jun 1987. Contract W-7405-ENG-48. 11p. (CONF-8706125—6). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011553.

From Conference on advances in cryogenic engineering; St. Charles, IL, USA (14 Jun 1987).

The cryogenic system for the Mirror Fusion Test Facility (MFTF) at Lawrence Livermore National Laboratory (LLNL) was designed to cool the entire MFTF-B system from ambient to operating temperature in less than 10 days. The system was successfully operated in the recent plant and capital equipment (PACE) acceptance tests, and results from these tests helped us correct problem areas and improve the system.

44746 **(UCRL—96832) Transport vehicle for manned Mars missions powered by inertial confinement fusion.** Orth, C.D.; Klein, G.; Sercel, J.; Hoffman, N.; Murray, K.; Chang-Diaz, F. (Lawrence Livermore National Lab., CA (USA); Jet Propulsion Lab., Pasadena, CA (USA); Rockwell International Corp., Canoga Park, CA (USA). Rocketdyne Div.; National Aeronautics and Space Administration, Houston, TX (USA). Lyndon B. Johnson Space Center). 26 Jun 1987. Contract W-7405-ENG-48. 12p. (CONF-8706157—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE87012909.

From 23. AIAA/SAE/ASME/ASEE joint propulsion conference; San Diego, CA, USA (29 Jun 1987).

Inertial confinement fusion (ICF) is an ideal engine power source for manned spacecraft to Mars because of its inherently high power-to-mass ratios and high specific impulses. We have produced a concept for a vehicle powered by ICF and utilizing a magnetic thrust chamber to avoid plasma thermalization with wall structures and the resultant degradation of specific impulse that are unavoidable with the use of mechanical thrust chambers. This vehicle is capable of 100-day manned Mars missions with a 100-metric-ton payload and a total vehicle launch mass near 6000 metric tons, based on advanced technology assumed to be available by A.D. 2020. Such short-duration missions minimize radiation exposures and physiological deterioration of astronauts.

44747 **Output optics for Aurora: Beam separation, pulse stacking, and target focusing.** McLeod, J. (Univ. of California, Los Alamos National Lab., P.O. Box 1663, MS E523, Los Alamos, NM 87545). *Fusion Technology;* **11**: No. 3, 654-670(May 1987).

An end-to-end technology demonstration prototype for large-scale ultraviolet laser systems of interest for short wavelength, inertial confinement fusion (ICF) investigations. The system is designed to employ optical angular multiplexing and serial amplification by electron-beam-driven KrF laser amplifiers to deliver to ICF targets a stack of pulses with a duration of 5 ns containing several kilojoules at a wavelength of 248 nm. The optical system has been designed in two phases. The first phase carries only through the amplifier train and does not include a target chamber or any demultiplexing. During first-phase design, the system was conceived of as only an amplifier demonstration and not as an end-to-end system demonstration. The design concept for second-phase optics that provides demultiplexing and carries the laser light to target is presented.

44748 **Improving inertial confinement fusion power plant and effective driver efficiencies by generating electricity from KrF laser reject heat.** Pendergrass, J.H. (Los Alamos National Lab., P.O. Box 1663, Mail Stop F611, Los Alamos, NM 87544). *Fusion Technology;* **11**: No. 3, 732(May 1987).

KrF laser intrinsic efficiency increases modestly with increase in lasing medium temperature up to at least a few hundred degrees Celsius. Such temperatures are high enough to permit efficient generation of electric power from the large amounts of heat that must be continuously removed from the lasing medium of a repetitively pulsed KrF laser in an inertial confinement fusion power plant. The effects of power generation from lasing medium heat on net plant efficiency and effective laser efficiency were investigated in a generic systems analysis. Two approaches to efficient, cost-effective generation of electric power from lasing medium heat were analyzed in detail: dedicated power generation systems that use lasing medium heat as the sole thermal energy source and the use of lasing medium thermal energy to heat main-plant steam cycle feedwater. Feedwater heating gives higher generation efficiencies and is more cost-effective than a dedicated system.

44749 **Comparisons of calculated and measured spectral distributions of neutrons from a 14-MeV neutron source inside the Tokamak Fusion Test Reactor.** Santoro, R.T.; Barnes, J.M.; Alsmiller, R.G. Jr.; Emme, M.B.; Drischler, J.D. (Oak Ridge National Lab., Engineering Physics and Math Div., P.O. Box X, Oak Ridge, TN 37831). *Fusion Technology;* **11**: No. 2, 420-428(Mar 1987). Contract AC05-84OR21400.

A recent paper presented neutron spectral distributions (energy $\geqq$ 0.91 MeV) measured at various locations around the Tokamak Fusion Test Reactor (TFTR) at the Princeton Plasma Physics Laboratory. The neutron source for the series of measurements was a small deuterium-tritium generator placed at various positions in the TFTR vacuum chamber. The results of neutron transport calculations are presented and compared with these experimental data. Applications to breeding blankets are discussed.

44750 **Photodetachment of negative ion beams in the presence of a background gas.** Fink, J.H. (Negion Inc., Hayward, CA). *Fusion Technology;* **11**: No. 2, 416-419(Mar 1987).

To suppress space charge blowup in an ion beam passing through a photoneutralizer, it is necessary to introduce some background gas. An analysis is presented of the neutralization of a high-energy, >200-keV negative deuterium ion beam, exposed to photodetachment while in the presence of deuterium. With a gas thickness of <0.01 Torr.cm, the neutral fraction in the output beam is found to be about the same as that gotten from the photoneutralizer operating in vacuum. Neutral atom beam injection for plasma heating is discussed.

99 GENERAL AND MISCELLANEOUS

REFER ALSO TO CITATION(S) 44505

44751 **(CONF-870538—3-FP) A disaster in retrospect: Hope for the future?.** Kenski, D.M. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011417.

From 34. international technical communication conference; Denver, CO, USA (10 May 1987).

Our editorial staff was recently put to the test by a major publishing disaster. The following paper describes the circumstances we found ourselves in, our frantic efforts to cope, and the lessons we learned from hindsight. This paper may help other hapless editors who find themselves confronted with similar situations.

44752 **(CONF-8710106—1) ARK: Acquiring and Reasoning about Knowledge.** Tonn, B.E.; Arrowood, L.F. (Oak Ridge National Lab., TN (USA)). 15 May 1987. Contract AC05-84OR21400. 14p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87012258.

From 3. annual expert systems in government conference; Washington, DC, USA (19 Oct 1987).

An automated knowledge acquisition system is being developed to elicit knowledge from experts during an interactive dialogue. ARK, for Acquiring and Reasoning about Knowledge, allows users to specify several types of propositional relationships and indicate the uncertainty associated with the truth of these propositions. Inconsistencies are identified dynamically through an assumption-based truth maintenance component. ARK's interactive dialogue also refines knowledge by identifying additional agents or conditions which affect objects.

44753 **(DOE/ER—0330) Guide for the preparation of proposals for the Pre-Freshman Engineering Program: PREP, 1988.** (USDOE Office of Energy Research, Washington, DC. University and Industry Programs Div.). Aug 1987. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012528.

Primary purpose of PREP will be to alleviate manpower shortages in engineering by preparing and guiding high school students in the selection of college-preparatory courses in science and mathematics. PREP will provide funds to colleges and universities for projects aimed at seeking out individuals during junior high school and high school years (grades 7-10) and providing them with pre-engineering enrichment experiences. This document is a guide for preparing the proposals.

44754 **(DOE/MA—0287-2) Listing of awardee names: active awards as of August 13, 1987.** (USDOE Assistant Secretary for Management and Administration, Washington, DC. Office of Review and Analysis). 13 Aug 1987. 572p. NTIS, PC A24/MF A01; 1; GPO Dep. File Number DE87013837.

This document is a computerized listing issued quarterly from the Procurement and Assistance Data System (PADS), including an alphabetical listing of all acquisition and financial assistance awards (excluding purchase orders) with the Department of Energy. Active is defined as the completion date of the award is later (in the future) than the date of the issuance of the listing.

44755 **(DOE/MA—0288-1) Listing of awardee names: Inactive awards as of May 1, 1987.** (USDOE Assistant Secretary for Management and Administration, Washington, DC. Office of Review and Analysis). 1987. 491p. NTIS, PC A21/MF A01; 1; GPO Dep. File Number DE87012001.

This document is a computerized listing issued quarterly from the Procurement and Assistance Data System (PADS), including an alphabetical listing of all acquisition and financial assistance awards (excluding purchase orders) with the Department of Energy. Inactive is defined as the completion date of the award is earlier (in the past) than the date of the issuance of the listing.

44756 **(DOE/MA—0288-2) Listing of awardee names: Inactive awards as of August 4, 1987.** (USDOE Assistant Secretary for Management and Administration, Washington, DC. Office of Review and Analysis). 4 Aug 1987. 460p. NTIS, PC A20/MF A01; 1; GPO Dep. File Number DE87013836.

This document is a computerized listing issued quarterly from the Procurement and Assistance Data System (PADS), including an alphabetical listing of all acquisition and financial assistance awards (excluding purchase orders) with the Department of Energy. Inactive is defined as the completion date of the award; it is earlier (in the past) than the date of the issuance of the listing.

44757 **(LA-UR—87-2603) Relevant literature in support of knowledge-based simulation models.** Morgeson, J.D.; Colston, E.; Burns, J.R. (Los Alamos National Lab., NM (USA); Texas Tech Univ., Lubbock (USA). Coll. of Business Administration). Jul 1987. Contract W-7405-ENG-36. 6p. (CONF-8710124—1). NTIS, PC A02. File Number DE87013178.

From Conference on systems, man, and cybernetics; Alexanderia, VA, USA (20 Oct 1987).

This article describes and references the relevant literature related to knowledge-based simulation. There are essentially ten areas of literature that would likely contain relevant articles. They are the management science/operations research literature, the simulation (and modeling) literature, the production/operations management literature, the knowledge engineering and artificial intelligence literature, the systems science literature, the industrial engi-

neering literature, the mechanical engineering literature, and the information science literature.

44758 **(LALP—87-10) Materials Science and Technology 1987 review.** (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 99p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87013329.

This review is divided into sections titled: research overview, programmatic overviews, technical highlights, capabilities, and profiles of branches of the divisions. (DLC)

44759 **(LBL—23283) Bridging the gap between first- and second-price auctions with withdrawable winning bids.** Rothkopf, M.H. (Lawrence Berkeley Lab., CA (USA)). 11 May 1987. Contract AC03-76SF00098. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013967.

This paper formulates and analyzes game-theoretic and decision-theoretic models of auctions in which bidders may submit multiple bids and, perhaps at cost, withdraw bids that are more aggressive than necessary to win. While such withdrawal strategies are currently surreptitious, legitimization would create market mechanisms intermediate between first-price and second-price auctions. We describe a particular auction in which a winning bid was withdrawn and fit one of our models to data from it.

44760 **(PPPL—2438) Injection and propagation of a nonrelativistic electron beam and spacecraft charging.** Okuda, H.; Berchem, J. (Princeton Univ., NJ (USA). Plasma Physics Lab.). May 1987. Contract AC02-76CH03073. 49p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013206.

Two-dimensional numerical simulations have been carried out in order to study the injection and propagation of a nonrelativistic electron beam from a spacecraft into a fully ionized plasma in a magnetic field. Contrary to the earlier results in one-dimension, a high density electron beam whose density is comparable to the ambient density can propagate into a plasma. A strong radial electric field resulting from the net charges in the beam causes the beam electrons to spread radially reducing the beam density. When the injection current exceeds the return current, significant charging of the spacecraft is observed along with the reflection of the injected electrons back to the spacecraft. Recent data on the electron beam injection from the Spacelab 1 (SEPAC) are discussed.

44761 **(SAND—87-0984) Instrumentation package for a shrouded SWERVE/EPW rocket sled test.** Garavaglia, E.G. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1987. Contract AC04-76DP00789. 42p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87014267.

A shrouded SWERVE test vehicle was instrumented and tested at MACH 3. The instrumentation consisted of accelerometers, pressure transducers, and event markers arranged in a nine-channel configuration. Data from the instrumentation were transmitted from the vehicle through an FM/FM telemetry system. Two fire sets and their associated command and controls were also included in this package. The event was recorded on high-speed color film, and the trajectory data were recorded by a laser tracker.

44762 **(UCRL—53812) Adaptive line of sight algorithms.** Tom, R.M. (Lawrence Livermore National Lab., CA (USA)). 25 Aug 1987. Contract W-7405-ENG-48. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014275.

The determination of obstructions of line of sight (LOS) between two arbitrary combat positions is a compute-intensive process for those simulators that model three-dimensional terrain. Computer implementation of LOS can dominate simulation run time for some scenarios. Relatively inexpensive computer systems are now becoming available that feature large random access memories. An adaptive procedure for LOS determination is contained in this concept paper that exploits the memory-rich environment to achieve increased speed of operation. Heuristic information about the way terrain LOS behaves in the real world plays a vital role in the procedure. A key feature of the approach is that is permits the order of LOS filters to be dynamically adjusted to test the most probable cause of obstruction first. The proposed algorithm permits a designer to effectively trade memory for run time and is aimed at a spectrum of machine sizes. The approach has the potential to be considerably more efficient than the algorithms now in use.

44763 **(UCRL—96697) Abregrams or deleweds: A forty-year view of acronyms.** Bowden, D.D. (Lawrence Livermore National Lab., CA (USA)). 29 May 1987. Contract W-7405-ENG-48. 14p. (CONF-871086—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010808.

From Institute of Electrical and Electronic Engineers Professional Communication Society conference; Winnipeg, Canada (14 Oct 1987).

New concepts often call for new words and abbreviated forms in the language. Not linguists, but persons who first envision, describe, and use new ideas are the ones who rearrange existing word combinations or create new terminology. Professional communicators do not prescribe usage, but can influence the selection of new words and especially acronyms. A practical knowledge of etymology, usage, and trends will help communicators make more discriminating choices.

9901 Management

REFER ALSO TO CITATION(S) 43285, 44799, 44813

44764 **(DOE/MA—0282) PGMO 3, Program resource management: Unit 3 of the Program Management Technical Skills Training Program.** (USDOE Assistant Secretary for Management and Administration, Washington, DC. Employee Development and Training Div.). Jun 1987. 460p. (PAD—77-9). NTIS, PC A20/MF A01; 1; GPO Dep. File Number DE87013099.

This document includes: terms used in the budgetary process, DOE appendix to terms used in the budget process, principles of federal appropriations law, GAO and executive-legislative relations, budget highlights, federal programs by function: meeting national needs, perspectives on the budget, the budget system and concepts, technical note on agency accounting and internal control, coordination and integration (DOE 11038), budget justification (DOE 11039), resource planning within DOE (DOE 11041), work authorization (DOE 11045), Strategic Petroleum Reserve program (DOE 11045), and Department of Energy - R and D project 180 (DOE 11044).

44765 **(SAND—86-2952C) Project management methodology for the Strategic Defense Facility.** Furaus, J.P.; Johnston, D.M.; Seamons, L.O.; Hanks, K.W.; Shirley, C.G.; Hands, J.A.; Byars, L.L.; Walla, M.L. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 11p. (CONF-8710103—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011716.

From Project Management Institute seminar/symposium; Milwaukee, WI, USA (2 Oct 1987).

The $70 M Strategic Defense Facility (SDF) in Albuquerque, New Mexico, will allow Sandia National Laboratories to conduct experimental research on future US strategic defensive weapon systems and the survivability of US systems against future threats. The project includes a four-story office building, equipment laboratories, support systems, and several state-of-the-art experimental machines. Managing this project requires integrating the facility, the support systems, and the equipment to produce a usable facility for the research community. Major projects have failed because up-front planning, configuration management, interface management, cost control, and quality assurance were inadequate. We have developed project management methodologies over the last ten years to prevent these inadequacies in our projects.

9902 Mathematics And Computers

REFER ALSO TO CITATION(S) 43824, 44634

44766 (AD-A—180814/6/XAB) Recent contributions of information sciences research at RAND to modeling- and simulation-based policy analysis. Donohue, G.L.; Poehlmann, K.; Vaiana, M. (RAND Corp., Santa Monica, CA (USA)). Mar 1987. 31p. (RAND/N—2555-RC). NTIS, PC A03/MF A01.

Original contains color plates; All DTIC and NTIS reproductions will be in black and white.

RAND's current research agenda involves not only the development of new tools and techniques but also applications of those tools to current policy-analysis issues. Recent research contributions include work in simulation methodology, parallel processing, and man-machine interface designs. This Note presents examples of this research: an interactive algebra tutor; an expert system designed to assist claims adjusters in asbestos litigation; a database management system applied to a network of emergency communications stations; and strategic and tactical wargaming applications. Now, as in the past, RAND provides a unique environment for information sciences research. An ongoing history of pure research has made key artificial intelligence and other computing techniques available to RAND scientists. The scientists have in turn recognized the powerful potential of these techniques and have used them effectively to address a variety of problems. At RAND, the analyst seeking the answer to an important policy question works side by side with computer specialists who strive to build new tools for the analyst's quest.

44767 (AD-A—180847/6/XAB) ParLance: a para-functional programming environment for parallel and distributed computing. Research report. Hudak, P.; Delosme, J.M.; Ipsen, I.C. (Yale Univ., New Haven, CT (USA). Dept. of Computer Science). Mar 1987. 37p. (YALEU/DCS/RR—524). NTIS, PC A03/MF A01.

This paper outlines the beginning of a collaborative research effort whose overall goal is the development of an effective parallel programming environment called ParLance, consisting of a para-functional language, highly-optimizing compiler, parallel evaluation kernel, and interactive support for parallel program development. ParLance is intended to be relatively machine-independent, with implementations planned for both a shared memory (ENCORE MultiMax) and a distributed-memory (INTEL iPSC) multiprocessor. Other machines to be considered include the Connection Machine and the WARP at CMU.

44768 (AD-A—180986/2/XAB) Framework for parallelism in frame-based reasoning. Wang, H.K.; DeFigueiredo, R.J. (Rice Univ., Houston, TX (USA). Dept. of Electrical Engineering). 1987. 20p. NTIS, PC A02/MF A01.

This paper discusses issues of parallelism within frame-based reasoning systems. This effort was motivated by the author's recent work on intelligent signal processing and visual-pattern recognition. Although rule-based systems prevail as knowledge engineering tools, frame-based systems are chosen because they provide a sound knowledge-representation scheme (including declarative and procedural knowledge) and a powerful (distributed) inference engine. A frame-based system developed at Rice University and NASA/JSC called WenLy was observed which is composed Wen, representing declarative knowledge, and Ly, representing procedural knowledge and taking charge of inference. Then two approaches are examined to achieve parallelism within that system. One is called the programming approach in which the frames are implemented on a parallel Lisp language. The order is called the architectural approach which supports MIMD computers with uniformed memory space. It is obvious that the list structure is a bottleneck to parallelism; on the other hand, it is crucial to frame-based reasoning due to its flexibility and uniformity. The authors feel they should sacrifice the degree of parallelism in exchange for a reasoning mechanism and knowledge structure that are closer to those of the human being.

44769 (AD-A—181067/0/XAB) Numerical methods for matrix computations using arrays of processors. Final report, 15 August 1983-15 October 1986. Golub, G.H. (Stanford Univ., CA (USA). Dept. of Computer Science). 30 Apr 1987. 6p. NTIS, PC A02/MF A01.

The basic objective of this project was to consider a large class of matrix computations with particular emphasis on algorithms that can be implemented on arrays of processors. In particular, methods useful for sparse matrix computations were investigated. These computations arise in a variety of applications such as the solution of partial differential equations by multigrid methods and in the fitting of geodetic data. Some of the methods developed have already found their use on some of the newly developed architectures.

44770 (AD-P—005294/4/XAB) Automating argument construction. Lowrance, J.D. (SRI International, Menlo Park, CA (USA). Artificial Intelligence Center). 16 Mar 1987. 20p. NTIS, PC A02/MF A01.

This article is from Workshop on Assessing Uncertainty Held in Monterey, California on 13-14 November 1986, AD-A180 850, 1-19.

Developed was Gister, which supports the construction, modification, and analysis of evidential arguments. Gister supports an interactive, menu-driven, graphical interface that allows these structures to be easily understood and manipulated. The user simply selects from a menu to add an evidential operation to an analysis, to modify operation parameters, or to change any portion of a gallery. In response, Gister updates the analyses, allowing the user to explore quickly the space of alternative arguments. Unlike other expert systems, Gister is designed as a tool for the domain expert. With this tool, an expert can quickly and flexibly develop a line of reasoning specific to a given domain situation. At SRI, this approach has been applied to naval intelligence problems. New work is focusing on adapting this technology to multisource data fusion for the Army.

44771 (ANL—86-56) An ITP workbook. Kalman, J.A. (Argonne National Lab., IL (USA)). Dec 1986. Contract W-31109-ENG-38. 99p. NTIS, PC A05/MF A01; GPO Dep. File Number DE87012856.

This collection of exercises has been prepared to teach the use of the automated reasoning system ITP. Previous knowledge of automated reasoning is not presumed. The exercises are designed for use with the UNIX operating system. (JDH)

44772 (CEA-CONF—8794) ADONIA, an expert help-system for the control of a data analysis. Malvache, P.; Reissan, S. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. des Reacteurs a Neutrons Rapides). Apr 1986. 20p. (In French). (CEA-DRNR-P—331; CONF-8604297—2). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752222.

From 6. international workshop on expert systems and their applications; Avignon, France (28 Apr 1986).

VAX11-780.

ADONIA is designed from pre-existing computer codes and integrates a know-how of the utilization of these tools and in the interpretation of their results. This system is aimed to users who are not experts in Data Analysis. This paper describes the original structure of such a system which couples symbolic and digital processing of data. The analysis of multidimensional data is used at the C.E.A. for the exploitation of experimental data sets and for the constitution of training tools aimed at application to Pattern Recognition. So ADONIA is the result of a joint work between the CEA and the GIA of Luminy who used to work with expert systems.

44773 (CEA-N—2493) Design and implementation of a software tool intended for simulation and test of real time codes. Le Louarn, C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)). Sep 1986. 232p. (In French). NTIS (US Sales Only), PC A11/MF A01. File Number DE87752204.

The objective of real time software testing is to show off processing errors and unobserved functional requirements or timing constraints in a code. In the perspective of safety analysis of nuclear equipments of power plants testing should be carried independently from the physical process (which is not generally available), and because casual hardware failures must be considered. We propose here a simulation and test tool, integrally software, with large interactive possibilities for testing assembly code running on microprocessor. The OST (outil d'aide a la simulation et au Test de logiciels temps reel) simulates code execution and hardware or software environment behaviour. Test execution is closely monitored and many useful informations are automatically saved. The present thesis work details, after exposing methods and tools dedicated to real time software, the OST system. We show the internal mechanisms and objects of the system: particularly "events" (which describe evolutions of the system under test) and mnemonics (which describe the variables). Then, we detail the interactive means available to the user for constructing the test data and the environment of the tested software. Finally, a prototype implementation is presented along with the results of the tests carried out. This demonstrates the many advantages of the use of an automatic tool over a manual investigation. As a conclusion, further developments, nececessary to complete the final tool are reviewed.

44774 **(CONF-870552—22) The design and performance of the parallel multiprocessor nuclear physics data acquisition system, DAPHNE.** Welch, L.C.; Moog, T.H.; Daly, R.T.; Videbaek, F. (Argonne National Lab., IL (USA)). May 1987. Contract W-31109-ENG-38. 5p. NTIS, PC A02. File Number DE87011453.

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (11 May 1987).

The ever increasing complexity of nuclear physics experiments places severe demands on computerized data acquisition systems. A natural evolution of these systems, taking advantages of the independent nature of "events," is to use identical parallel microcomputers in a front end to simultaneously analyze separate events. Such a system has been developed at Argonne to serve the needs of the experimental program of ATLAS, a new superconducting heavy-ion accelerator and other on-going research. Using microcomputers based on the National Semiconductor 32016 microprocessor housed in a Multibus I cage, CPU power equivalent to several VAXs is obtained at a fraction of the cost of one VAX. The front end interfacs to a VAX 11/750 on which an extensive user friendly command language based on DCL resides. The whole system, known as DAPHNE, also provides the means to reply data using the same command language. Design concepts, data structures, performance, and experience to data are discussed.

44775 **(CONF-870706—3) Computer simulation of diffusion in pore networks.** Burganos, V.N.; Sotirchos, S.V. (Rochester Univ., NY (USA). Dept. of Chemical Engineering). 1987. Contract FG22-85PC80520. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013673.

From Summer computer simulation conference; Montreal, Canada (27 Jul 1987).

A method is formulated for the numerical estimation of effective diffusivities in random pore (capillary) systems exhibiting significant overlapping. Attention is focused on the problem of diffusion in the Knudsen regime, both with relatively minor modifications the method may also be employed to investigate self-diffusion of gases in pore networks in the intermediate transition regime. The method is based on elements from the kinetic theory of gases and consists of two independent Monte Carlo simulation techniques. A random structure is created by statistical sampling from prescribed pore size and orientation distributions. The construction of the pore network is followed by a modified, to account for pore overlap, version of the "test particle"method (Davis, 1960; Bird, 1976) for collisionless flows in tubes, the results of which are then used for the estimation of the effective Knudsen diffusivity in the pore network. The developed method can in principle be applied to any structure of overlapping pores, but in this paper our work is focused on the investigation of diffusion in a structure of parallel, randomly overlapping pores. The "test particle" method employs a sample of the porous medium confined between two parallel planes, perpendicular to the macroscopic concentration gradient, and consists in following the trajectories of a large number of molecules that enter the sample through one of these planes. 17 refs., 9 figs.

44776 **(CONF-870831—3) The Task-Level Data Flow Language (TDFL).** Suhler, P.A.; Biswas, J. (Texas Univ., Austin (USA)). 1987. Contract FG05-85ER25010. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012953.

From International conference on parallel processing; St. Charles, IL, USA (17 Aug 1987).

A Task-Level Data Flow Language (TDFL) program represents a computation as a graph having nodes connected by directed arcs. As nodes contain subroutine-sized tasks, this is considered to be coarse-grained parallelism. This paper presents the language definition, describes its implementation on the Sequent Balance shared-memory multiprocessors, and presents some programs and their performance figures. Comparisons with other data flow languages are also made.

44777 **(DOE/ER/25010—2) A unified approach to parallel computation: Performance evaluation and architecturally independent parallel programming: Progress report, September 1, 1986-August 31, 1987.** Browne, J.C. (Texas Univ., Austin (USA). Dept. of Computer Sciences). 15 May 1987. Contract FG05-85ER25010. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87012519.

This report is a summary of research in the area of parallel programming. Research accomplishments include formalization of a model of parallel computation, application of the model to architecturally independent graphics problems, and resource management of parallel architectures. (JDH)

44778 **(DOE/ER/25010—T2) Simultaneous update of priority structures.** Biswas, J.; Browne, J.C. (Texas Univ., Austin (USA). Dept. of Computer Sciences). 1987. Contract FG05-85ER25010. 9p. NTIS, PC A02. File Number DE87012954.

To avoid centralized bottlenecks, data structures for multiple computer systems must be simultaneously updatable and yet must have some coherent and consistent state. This can be achieved through judicious partitioning of system data structures and control of access to them in such a manner that (1) either different processes operate upon disjoint segments of a given structure; or (2) processes operate upon the same datum object, in a controlled manner. Partitioning of data structures can be by structure or content. It can also occur at multiple times. In this paper we demonstrate content partitioning of a k-ary tree data structure at runtime, to realize a simultaneously updatable priority queue. The tree algorithms are then generalized to banyan data structures and shown to possess attractive properties of simultaneous update and throughput.

44779 **(DOE/ER/25010—T3) A design methodology for algorithm-specific architectures.** Deshpande, S.R.; Browne, J.C. (Texas Univ., Austin (USA). Dept. of Computer Sciences). Feb 1987. Contract FG05-85ER25010. 33p. (TR—87-06). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012955.

The optimality criterion of keeping the utilization of the resources of a dedicated, special purpose architecture to the maximum is interpreted as being equivalent to keeping them busy at all times. This is in turn understood in terms of the concept of conservation of tokens. The problem of designing an optimal architecture is expressed in terms of a system of simultaneous equations. It is shown that it is possible to build an optimal architecture, if and only if, an integer solution exists for the set of equations. A particular instance of the Generalized Linear Pipeline is illustrated as an example of such an architectural design. It is also shown that solutions exist for trees and graphs which are combinations of trees. Furthermore, certain conditions are specified, which when satisfied ensure integer solutions for non-tree computation graphs.

44780 (JAERI-M—87-062) Vectorization of MHD equilibrium and stability codes. Nemoto, Toshiyuki; Tsunematsu, Toshihide. (Japan Atomic Energy Research Inst., Tokyo). Apr 1987. 40p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87753013.

An MHD equilibrium code (SELENE) and a stability code (ERATO-J) are extensively used for the analysis of ideal MHD beta limit of a tokamak plasma. High efficiency is required for the analysis of experimental data and the design of the next step fusion experimental devices. In the report, the methods of vectorization are described as well as the basic equations and numerical methods. Vectorization reduces the comptational time to about a third through a quarter of the original version on Fujitsu VP-100.

44781 (LA—11020-MS) Boundary integral technique for performing analysis of two-dimensional volumes of revolution. Dolin, R.M. (Los Alamos National Lab., NM (USA)). Aug 1987. Contract W-7405-ENG-36. 80p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87013053.

This report describes how beam and mass property analysis is performed within the initial graphics exchange specification (IGES)-compatible code called IGVIEW. This software is used at the Los Alamos National Laboratory to display and edit two-dimensional IGES-formatted geometry. IGVIEW was written to comply with IGES version 4.0, which is the current national geometry standard. This report discusses how IGVIEW uniquely defines parts and how geometry is analyzed using a boundary integral technique. The development of the boundary integral equations is provided.

44782 (LBL—23625) Run-time partitioning of scientific continuum calculations running on multiprocessors. Baden, S.B. (Lawrence Berkeley Lab., CA (USA)). Jun 1987. Contract AC03-76SF00098. 153p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87012711.

A wide range of scientific continuum calculations typically concentrate computational effort non-uniformly over localized regions of physical space. We present a run-time partitioning strategy, intended for such methods, that distributes work evenly across a team of processors and that can exploit the spatial localization present in the original computation in order to avoid high overhead costs. We tried out our strategy on Anderson's Method of Local Corrections, a type of vortex method for computational fluid dynamics. Because computational effort follows particles that congregate and disperse irregularly about the domain, this problem is hard to partition in a way that distributes the work evenly among the processors. We ran experiments on 32 processors of an Intel Personal Scientific Computer - a message-passing hypercube multiprocessor - and on 4 processors of a Cray X-MP - a shared-memory vector architecture - and achieved good parallel speedups of 22 and 3.6, respectively. The partitioner may be implemented as a virtual machine (VM) and made available to the programmer as a library of run-time utilities. The semantics of the VM are insensitive to the application and to the computer architecture on which the VM is implemented. The VM works with ordinary programming languages, incurs modest overhead costs, and requires no special hardware support. It should apply to diverse applications, including finite difference methods, and to diverse architectures without requiring that the application be reprogrammed extensively for each new architecture.

44783 (LBL-PUB—3062) EVA reference manual. Belshe, R.A. (Lawrence Berkeley Lab., CA (USA)). Jun 1987. Contract AC03-76SF00098. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87014073.

EVA is a program used for creating one-dimensional (1-D) and two-dimensional (2-D) spectra from event tapes. In order to create these spectra an algorithm is written in the EVAL language which describes both the structure of a single event and the analysis to be done on each event. The process of sorting an event tape is then simply to repeat this algorithm for each of the millions of events on the tape. The EVA language has been defined to easily describe such algorithms, and a compiler has been written to produce optimum machine code for each individual set of sorting conditions. This allows the user full control over the handling of the events and produces code which runs much faster than a generalized FORTRAN program. This manual describes the implementation of sorting programs using the EVA compiler for the Modcomp CLASSIC computers at LBL. When used with the program GATES, it allows free-form 2-dimensional regions to be used as gates.

44784 (N—87-22424) Programming techniques for high-speed processing and verification with the NEC supercomputer SX system. Nakamura, K.; Yoshida, M.; Mineo, S. (National Aerospace Lab., Chofu, Tokyo (Japan)). 1986. 55p. (NAL-TR—909). NTIS, PC A04/MF A01.

Various methods of effective FORTRAN programming to increase vectorization rates and conduct high-speed processing of FORTRAN programs for supercomputers are presented. The methods are used to tune up the National Aerospace Laboratory application software package, AFMESH, which is a two-dimensional grid generation program, and INVERSE, which is a two-dimensional airfoil design program. The tuned-up programs are executed with the NEC supercomputer SX-2 system and computing times compared with the times of the original programs show the usefulness of the methods.

44785 (N—87-22444) Problem size, parallel architecture and optimal speedup. Nicol, D.M.; Willard, F.H. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). Apr 1987. 31p. (NASA-CR—178282; ICASE—87-7; NAS—1.26:178282). NTIS, PC A03/MF A01.

Final Report.

The communication and synchronization overhead inherent in parallel processing can lead to situations where adding processors to the solution method actually increases execution time. Problem type, problem size, and architecture type all affect the optimal number of processors to employ. The numerical solution of an elliptic partial differential equation is examined in order to study the relationship between problem size and architecture. The equation's domain is discretized into n sup 2 grid points which are divided into partitions and mapped onto the individual processor memories. The relationships between grid size, stencil type, partitioning strategy, processor execution time, and communication network type are analytically quantified. In so doing, the optimal number of processors was determined to assign to the solution, and identified (1) the smallest grid size which fully benefits from using all available processors, (2) the leverage on performance given by increasing processor speed or communication network speed, and (3) the suitability of various architectures for large numerical problems.

44786 (N—87-23201) Static data flow simulation study at Ames Research Center. Barszcz, E.; Howard, L.S. (National Aeronautics and Space Administration, Moffett Field, CA (USA). Ames Research Center). Jun 1987. 23p. (NASA-TM—89434; A—87129; NAS—1.15:89434; CONF-870831—4). NTIS, PC A02/MF A01.

From International conference on parallel processing; St. Charles, IL, USA (17 Aug 1987).

Demands in computational power, particularly in the area of computational fluid dynamics (CFD), led NASA Ames Research Center to study advanced computer architectures. One architecture being studied is the static data flow architecture based on research done by Jack B. Dennis at MIT. To improve understanding of this architecture, a static data flow simulator, written in Pascal, has been implemented for use on a Cray X-MP/48. A matrix multiply and a two-dimensional fast Fourier transform (FFT), two algorithms used in CFD work at Ames, have been run on the simulator. Execution times can vary by a factor of more than 2 depending on the partitioning method used to assign instructions to processing elements. Service time for matching tokens has proved to be a major bottleneck. Loop control and array address calculation overhead can double the execution time. The best sustained MFLOPS rates were less than 50% of the maximum capability of the machine.

44787 **(ORNL/TM—10316) Naval Aviation Integrated Logistics: Technical users guide version 1.0.** DeLozier, R.C.; Holder, D.A. (Oak Ridge National Lab., TN (USA)). Jun 1987. Contract AC05-84OR21400. 330p. NTIS, PC A15/MF A01; 1; GPO Dep. File Number DE87013368.

This document summarizes the operational and analytical functions of version 1.0 of the Naval Aviation Integrated Logistic (NAIL) package. NAIL, a logistics management and analysis system, creates standardized reports and performs several categories of statistical operations in support of NAVAIR logistic analytic functions.

44788 **(SAND—86-0914) DETOUR: A deformed mesh/contour plot program.** Gilkey, A.P.; Flanagan, D.P. (Sandia National Labs., Albuquerque, NM (USA)). Jul 1987. Contract AC04-76DP00789. 57p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87013119.

DETOUR is a graphics program for the post-processing of two-dimensional finite element analyses. It produces mesh plots with various representations of the analysis output variables. The major capabilities of DETOUR are deformed mesh plots, line contours, filled (painted) contours, vector plots of two variables (e.g., velocity vectors), and symbol plots of scalar variables (e.g., discrete cracks). DETOUR's features include free-format command input, element selection by material, element birth and death, multiple views for combining several displays on each plot, and symmetry mirroring. DETOUR can drive any graphics device supported by the Sandia Virtual Device Interface and operates in either interactive or batch modes.

44789 **(SAND—87-0292C) A comparison of experiment, CEPXS/ONETRAN, TIGERP, and QUICKE2 net electron emission coefficients for various bremsstrahlung spectra.** Ballard, W.P.; Lorence, L.J. Jr.; Snowden, D.P.; van Lint, V.A.J.; Beale, E.S. (Sandia National Labs., Albuquerque, NM (USA); Mission Research Corp., San Diego, CA (USA)). 1987. Contract AC04-76DP00789. 18p. (CONF-870724—16). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012370.

From 24. annual conference on nuclear and space radiation in electronics; Snowmass, CO, USA (28 Jul 1987).

This work compares a carefully designed experiment with the predictions of four different codes (CEPXS/ONETRAN, TIGERP, TIGER and QUICKE2) for the complex bremsstrahlung spectra typical of very intense pulsed power x-ray generators. Accurate calculation of net photon-induced electron emission yields at material interfaces using Monte Carlo codes can be particularly difficult if the forward and reverse partial yields are of similar magnitudes. In such a circumstance, the statistical error in the Monte Carlo solution (TIGER or TIGERP) must be kept to a minimum to accurately resolve the difference. CEPXS/ONETRAN is a new deterministic coupled electron/photon transport code that is faster than Monte Carlo and is not subject to statistical error. QUICKE2 evaluates an analytical approximation and is also much less expensive to run than the Monte Carlo codes. The comparison of net yields is a sensitive test of the relative accuracy and efficiency of these various codes. We find that all of the codes except QUICKE2 substantially agree with the experiments for the forward net yields. Howver, for reverse net yields from high-Z materials, all the codes overpredict relative to measurements.

44790 **(SAND—87-0662C) Hydrocode benchmarking of 1-D shock vaporization experiments.** Trucano, T.G.; Asay, J.R.; Chhabildas, L.C. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-870753—44). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012974.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

In this paper computational work that simulates shock-vaporization experiments is discussed. Two aspects of this work are described: first, the use of numerical simulation in providing information that assists the process of experimental design, and, second, the use of numerical simulations in extracting equation-of-state (EOS) information from these experiments. Our computational activities in this area are quite extensive, and support our belief that these experiments provide a new and unique capability for diagnosing hot, expanded states of metals.

44791 **(SAND—87-1745C) Simulations using the pseudo-current algorithm.** Marder, B.M. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-870947—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012403.

From 12. conference on the numerical simulation of plasmas; San Francisco, CA, USA (20 Sep 1987).

The pseudo-current algorithm in electromagnetic particle-in-cell codes is a method for keeping the error in Gauss' Law bounded by some predetermined tolerance. It places no restrictions on how charge and current density are computed. In particular, simple area weighting can be used. Nor does the technique require solving elliptic equations. What it does is diffuses away errors generated by local numerical inaccuracies in a manner consistent with Maxwell's equations. This technique, as described in this report, has been used in numerical simulations of microwave generating devices such as magnetrons, backward wave oscillators, and a new device developed in large part through the simulations, the magnetically insulated transmission line oscillator, or MILO.

44792 **(SLAC-PUB—4345) Towards a personal mainframe.** Aston, D. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Jun 1987. Contract AC03-76SF00515. 6p. (CONF-870249—9). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012317.

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

Aspects of computing in a mainframe environment are discussed with reference to the SLAC installation. Personal computers have revolutionized users' expectations, yet the centralized mainframe continues to offer indispensable advantages. Many of the components of a user-friendly environment can now be identified, but much work remains to be done in order to integrate them satisfactorily.

44793 **(SOL—87-8) Comparisons of composite simplex algorithms.** Lustig, I.J. (Stanford Univ., CA (USA). Systems Optimization Lab.). Jun 1987. Contract FG03-87ER25028. 71p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87012728.

For almost forty years, the simplex method has been the method of choice for solving linear programs. The method consists of first finding a feasible solution to the problem (Phase I), followed by finding the optimum (Phase II). Many algorithms have been proposed which try to combine the processes embedded in the two-phase process. This study will compare the merits of some of these composite algorithms. Theoretical and computational aspects of the Weighted Objective, Self-Dual Parametric, and Markowitz Criteria algorithms are presented. Different variants of the Self-Dual methods are discussed. A large amount of computational experience for each algorithm is presented. These results are used to compare the algorithms in various ways. The implementations of each algorithm are also discussed. One theme that is present throughout all of the computational experience is that there is no one algorithm which is the best algorithm for all problems.

44794 **(UCID—19592-Rev.3) DYNA3D user's manual (nonlinear dynamic analysis of structures in three dimensions).** Hallquist, J.O.; Benson, D.J. (Lawrence Livermore National Lab., CA (USA)). Jul 1987. Contract W-7405-ENG-48. 172p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87012830.

This report provides an updated user's manual for DYNA3D, an explicit three-dimensional finite element code for analyzing the large deformation dynamic response of inelastic solids and structures. A contact-impact algorithm permits gaps and sliding along material interfaces with friction. By a specialization of this algorithm, such interfaces can be rigidly tied to admit variable zoning without the need of transition regions. Spatial discretization is achieved by the use of 8-node solid elements, 2-node beam elements, 4-node shell elements, 8-node solid shell elements, and rigid

bodies. The equations-of-motion are integrated in time by the central difference method. DYNA3D contains twenty-five material models and eleven equations of state to cover a wide range of material behavior.

44795 **(UCID—20545) TIPS-1 user's manual: Cray-1 version.** Laguna, G.W. (Lawrence Livermore National Lab., CA (USA)). 15 Jul 1987. Contract W-7405-ENG-48. 111p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87013297.

This report provides a user's manual for the Lawrence Livermore National Laboratory (LLNL) version of the solid modeler TIPS-1. TIPS-1/LLNL allows users to define complete geometric and topological descriptions of objects which can then be acted upon by applications such as mass properties, graphics, and radiograph simulations. TIPS-1/LLNL is available only on the Crays.

44796 **(UCID—21107) An empirical study of normalized timing requirements for various standard operations.** Toms, R.M. (Lawrence Livermore National Lab., CA (USA)). 18 Jun 1987. Contract W-7405-ENG-48. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013218.

Simulations are notorious for being among the most expensive of all computational tasks. In many engineering, military and scientific computer installations processing time is devoted almost exclusively to simulation. The execution of one simulation can take many hours of computer time. When the simulation model is probablistic or if sensitivity analysis is necessary, many replications may be needed to accurately determine the results. Substantive cost improvements can be achieved by designing simulators with efficiency of operation emphasized from the outset. This report contains normalized timing data that can help programmers make design tradeoffs which will lead to more efficient code.

44797 **(UCID—21115) SISAL multiprocessing support.** Cann, D.C.; Ching-Cheng Lee; Skedzielewski, S.K.; Oldehoeft, R.R. (Lawrence Livermore National Lab., CA (USA)). 15 Jul 1987. Contract W-7405-ENG-48. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013574.

In this document the microtasking environment supporting both sequential and parallel execution of SISAL is examined. First the internal mechanics of the environment are defined. Then, a built-in facility for statically slicing forall loops is introduced. And last, the implementation of SISAL streams is discussed. They provide an excellent medium by which to exploit pipelined parallelism.

44798 **(UCRL—15924) On modeling the solution of PDE Problems II.** Greiman, W.H.; Shlaer, S.; Balaban, D.; Garbarini, J.; Olwell, K. (Project Technology, Inc., Berkeley, CA (USA); Lawrence Livermore National Lab., CA (USA)). 29 Jun 1987. Contract W-7405-ENG-48. 110p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87012912.

The primary objective of this research is to develop an automatic programming (AP) system which will take as input a natural two dimensional interactive mathematical specification of a partial differential equation (PDE) problem from physics and produce as output an efficient program for computing an accurate numerical approximation to the solution of the problem. This AP system must be able to handle problems of practical import to computational physicists. A secondary objective of this research is to develop abstract, implementation independent models for the AP system. These models will provide a theoretical foundation for the project. The rigor provided by these models will make it possible to isolate and solve critical research problems. These abstract models will be the medium by which important concepts developed by the project will survive any particular implementation of the automatic code generation system. This paper reports progress to date and details experiment planning for future work.

44799 **(UCRL—96282) Product definition management: The next challenge.** Trost, S.R. (Lawrence Livermore National Lab., CA (USA)). 10 Mar 1987. Contract W-7405-ENG-48. 16p. (CONF-8704167—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87011920.

From Conference on computer aided design/computer aided manufacturing databases 1987: users take charge; San Francisco, CA, USA (6 Apr 1987).

Lawrence Livermore National Laboratory is participating in a multi-year program to provide full CIM (Computer Integrated Manufacturing) capability for its manufacturing complex problems. Success has been achieved in data transfer, using secure electronic transmission and the IGES standard. However, to obtain maximum productivity, planning is being performed to develop and implement a complete product definition model. This paper discusses the background of this current project, and outlines the plans and challenges presented by this new goal.

44800 **(UCRL—96531) Uncertainties in maximum entropy (ME) reconstructions.** Bevensee, R.M. (Lawrence Livermore National Lab., CA (USA)). Apr 1987. Contract W-7405-ENG-48. 5p. (CONF-8709108—1). NTIS, PC A02. File Number DE87011327.

From Digital signal processing conference; Florence, Italy (7 Sep 1987).

This paper summarizes recent work done at the Lawrence Livermore National Laboratory by the writer on the effects of statistical uncertainty and image noise in Boltzmann ME inversion. The object of this work is the formulation of a Theory of Uncertainties which would allow one to compute confidence intervals for an object parameter near an ME reference value.

44801 **(Y/CSD/INF—87-4) A user's guide to the PICTEK utility for displaying Lotus 1-2-3 graphics files using a Tektronix 4107 graphics terminal or emulator.** Cobb, C.K. (Oak Ridge Y-12 Plant, TN (USA)). Apr 1987. Contract AC05-84OS21400. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012328.

The PICTEK utility, which currently resides on the OC2VAX and OCU VAX computer systems at the Oak Ridge Y-12 Plant, converts a Lotus 1-2-3 graphics file into a Tektronix 4107 graphics file that is displayed using a Tektronix 4107 graphics terminal or emulator. The PICTEK utility provides users on the broadband network the ability to share Lotus 1-2-3 graphics files that are originally generated on IBM Personal Computers. In order to display a Lotus 1-2-3 graphics file using the PICTEK utility, the user must use the Kermit protocol to transmit the Lotus 1-2-3 graphics file from an IBM Personal Computer to the desired VAX system in binary mode. The PICTEK utility provides an option for the user to save the Tektronix 4107 graphics file so that it may be subsequently displayed simply by entering a TYPE command.

44802 **Hypercube multiprocessors 1986.** Heath, M.T. Philadelphia, PA; Society for Industrial and Applied Mathematics (1986). 294p.

The present conference discusses a VLSI parallel supercomputer, a message-based architecture for high concurrency, multiprocessor programming with distributed variables, the Crystal synthesis approach to parallel machine programming, and virtual time and time-warp on the JPL hypercube. Also discussed are the ROSES scheduler for precedence-constrained tasks on concurrent multiprocessors, matrix factorization on a hypercube multiprocessor, matrix computation on distributed memory multiprocessors, the solution of elliptic partial differential equations on hypercubes, hypercube programs for computational fluid dynamics, and concurrent computation in light of the theory of complex systems.

44803 **Hypercube - a tutorial overview.** Heath, M.T. pp 7-10 of Hypercube multiprocessors 1986. Heath, M.T. Philadelphia, PA; Society for Industrial and Applied Mathematics (1986).

The hypercube is a distributed-memory, message-passing multiprocessor which is more easily scaled up to very large numbers of processors than systems based on globally shared memory. The hypercube network is sufficiently densely connected to support efficient communication between arbitrary processors, yet also sufficiently sparse to be relatively easily and inexpensively built. It is also flexible enough to allow such interconnection topologies as rings, grids, trees, etc., to be embedded in the hypercube, rendering it an ideal test-bed for experimentation with parallel algorithms in-

tended for many types of distributed-memory, message-passing multiprocessors.

9903 Information Handling

REFER ALSO TO CITATION(S) 43819, 44766, 44767, 44787, 44799

44804 **(CONF-870899—2) High performance clause indexing.** Butler, R.; Stevens, R. (University of North Florida, Jacksonville (USA). Dept. of Computer Science; Argonne National Lab., IL (USA)). 21 Feb 1987. Contract W-31109-ENG-38. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011399.

From 4. symposium on logic programming; San Francisco, CA, USA (31 Aug 1987).

Techniques used by most Prolog implementations for indexing clauses are too slow for applications that may have tens of thousands of clauses in a database. A preliminary implementation of clause indexing based on the idea of codewords is presented. In the present scheme the codeword indexing is used only for large in-memory clause databases and not for general Prolog procedures. Early experimental results suggest that this may be a way to effectively manage large numbers of structurally similar clauses. Some results on retrievals in a formula database of up to 11,000 clauses are presented.

44805 (KURRI-TR—274, pp 67-73) **Data base of reactor physics experimental results in Kyoto University critical assembly experimental facilities.** Ichihara, Chihiro; Fujine, Shigenori; Hayashi, Masatoshi. (Kyoto Univ., Kumatori, Osaka, Japan. Research Reactor Inst.). Feb 1986. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. File Number DE87780151. (CONF-8507155—).

From Specialist research meetings on nuclear science information; Kumatori, Japan (22 Jul 1985).

The Kyoto University critical assembly experimental facilities belong to the Kyoto University Research Reactor Institute, and are the versatile critical assembly constructed for experimentally studying reactor physics and reactor engineering. The facilities are those for common utilization by universities in whole Japan. During more than ten years since the initial criticality in 1974, various experiments on reactor physics and reactor engineering have been carried out using many experimental facilities such as two solidmoderated cores, a light water-moderated core and a neutron generator. The kinds of the experiment carried out were diverse, and to find out the required data from them is very troublesome, accordingly it has become necessary to make a data base which can be processed by a computer with the data accumulated during the past more than ten years. The outline of the data base, the data base CAEX using personal computers, the data base supported by a large computer and so on are reported. (Kako, I.).

44806 (KURRI-TR—274, pp 23-32) **Present status and trends of INIS.** Yokoo, Hiroshi. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Feb 1986. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. File Number DE87780151. (CONF-8507155—).

From Specialist research meetings on nuclear science information; Kumatori, Japan (22 Jul 1985).

The framework for management and activities of INIS (International Nuclear Information System) is outlined on the basis of the rule 'Definition of Membership Arragement for INIS' which was approved by IAEA in 1985. Recent statistical figures are shown on INIS input, which are itemized by inputting country, subject category, literature type and language. Also shown are various INIS retrieval services in Japan and INIS on-line service by direct access to IAEA from Member States. 'General Review of INIS Operations' has been made by IAEA in cooperation with Member States since the beginning of 1985. Main topics of the review are presented on subject scope, coverage, timeliness and assistance to developing countries.

44807 (KURRI-TR—274, pp 1-10) **Formation, circulation and utilization of data bases in nuclear fusion research.** Konishi, Osamu. (Nagoya Univ., Japan. Inst. of Plasma Physics). Feb 1986. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. File Number DE87780151. (CONF-8507155—).

From Specialist research meetings on nuclear science information; Kumatori, Japan (22 Jul 1985).

Recent nuclear fusion research has developed to a synthetic research which requires the researches in wide special fields, not limited to the field of conventional plasma science and technology. For the promotion of research, it is necessary to utilize diversified and a large amount of scientific information, and for this purpose, it is necessary to collect positively the information required for the research, to evaluate and systematize it. Moreover, in order to connect the diversified research subjects related to nuclear fusion research as a whole, it is important to clarify the future perspective, possible development and interrelation with other subjects of respective research subjects. In the situation like this, Nuclear Fusion Research Planning Information Center, Institute of Plasma Physics, Nagoya University, was established in 1977. Data base activity is an important part of the various activities for achieving the objective. In this report, from the viewpoint of the present status and features of the data base and the effect of utilizing the data base, the method of utilization as the base of research activity is discussed. The data base activity comprises the preparation of data base, the offer of data and the utilization for research planning. (Kako, I.).

44808 (KURRI-TR—274, pp 33-37) **Present status of Kyoto University reactor research result data base KURRIP.** Takeuchi, Takayuki. (Kyoto Univ., Kumatori, Osaka, Japan. Research Reactor Inst.). Feb 1986. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. File Number DE87780151. (CONF-8507155—).

From Specialist research meetings on nuclear science information; Kumatori, Japan (22 Jul 1985).

The construction of KURRIP data base was begun in 1982, and in 1983, the data base concerning the literatures published in five years from 1978 to 1982 was set up in the Kyoto University Large Computer Center, and it has become available generally. In fiscal year 1984, the data concerning the literatures published from 1974 to 1977 and in 1983 were added. Moreover in this fiscal year, the work is carried out to input the data concerning the literatures published from 1970 to 1973 and in 1984. The data retrievable at present are those for ten years from 1974 to 1983. The results of having retrieved these data about a number of items are reported in this paper. The classification according to the places of employment of authors, the classification according to the kinds of literatures, the classification according to the languages used, the classification according to the installations used, the classification according to the fields of research, and the classification according to the magazines which printed the data are reported. (Kako, I.).

44809 **(KURRI-TR—274) Proceedings of the specialist research meetings on nuclear science information, (6).** Takeuchi, Takayuki; Mizuma, Mitsuo; Kimura, Itsuro (eds.). (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.). Feb 1986. vp. (In Japanese). (CONF-8507155—). NTIS (US Sales Only), PC A05/MF A01. File Number DE87780151.

From Specialist research meetings on nuclear science information; Kumatori, Japan (22 Jul 1985).

Individual papers have been cataloged separately. (WRF)

44810 **(LA-UR—87-2187) Using the NeWS window system in a Cray environment.** Phillips, R.L.; Forslund, D.W. (Los Alamos National Lab., NM (USA)). Jun 1987. Contract W-7405-ENG-36. 18p. (CONF-8704165—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011735.

From Cray User Group spring meeting; New York City, NY, USA (21 Apr 1987).

NeWS is structured as a single UNIX process, a network server that contains a PostScript interpreter. Client programs, which exist somewhere out on the network, talk to NeWS through byte streams. This paper describes the implementation of such a

client interface on a Cray running the UNICOS operating system. With only a modest effort, it is possible to fit a simple PostScript interface to existing mainframe applications, which allows the user to graphically interact with the program from a remote workstation. Some typical applications, which have been structured as NeWS clients, have been described.

44811 **(LBL—22393) A new compression method with fast searching on large databases.** Li, J.Z.; Rotem, D.; Wong, H.K.T. (Lawrence Berkeley Lab., CA (USA)). Mar 1987. Contract AC03-76SF00098. 23p. (CONF-870996—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010986.

From 13. international conference on very large data bases; Brighton, UK (1 Sep 1987).

In this paper, a new compression method for constant removal from very large scientific and statistical databases is presented. The new method combines the best features from several classical constant removal compression methods. The result, both analytical and experimental, shows that the method is superior to these popular methods in terms of compression effectiveness and efficient searching on the compressed data. In addition to the development, analysis and validation of this new method, this paper also presents analysis of several traditional constant removal methods for the purpose of analytic comparison. A large collection of experiments have been designed and run to observe and validate the behavior of the compression methods. Another contribution of the paper is that performance characteristics are identified for different compression methods under different data properties assumptions. The result can be used as a basis of selecting compression methods by matching the properties of the database at hand to the data properties experimented in the paper.

44812 **(LBL—23601) Problems in integrating geographic data.** Merrill, D.W. Jr. (Lawrence Berkeley Lab., CA (USA)). May 1987. Contract AC03-76SF00098. 9p. (CONF-8705147—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012880.

From Piecing the puzzle together: a conference on integrating data for decisionmaking; Washington, DC, USA (27 May 1987).

Four major types of integrated data systems are: bibliographic, econometric, demographic, and composite. An example of the latter type is Lawrence Berkeley Laboratory's Socio-Economic Environmental Demographic Information System (SEEDIS). Selected SEEDIS data can be downloaded in various self-describing formats, for combination with the user's private data. The problem of combining data at different geographic levels (e.g., 1970 vs 1980 counties) is discussed. SEEDIS defines over 120 different levels and the relationships between them. Data can be automatically converted from one level to another with the use of geographic correspondence files. Data measured at discrete points, e.g., air quality, can be estimated for population units (e.g., census tracts) by various techniques including interpolation and two-dimensional weighted averaging. Density-equalizing map projections (cartograms) provide a means of analyzing geographic distributions when events are too sparse for reliable calculations of rates. 8 refs.

44813 **(SAND—87-0944C) Emergency Management Information System (EMINS).** Desonier, L.M. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 4p. (CONF-870713—18). NTIS, PC A02. File Number DE87011865.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

In a time of crisis or in an emergency, a manager is required to make many decisions to facilitate the proper solution and conclusion to the emergency or crisis. In order to make these decisions, it is necessary for the manager to have correct up-to-date information on the situation, which calls for an automated information display and entry process. The information handling needs are identified in terms of data, video, and voice. Studies of existing Emergency Operations Centers and evaluations of hardware and software have been completed. The result of these studies and investigations is the design and implementation of an automated Emergency Management Information System. Not only is the system useful for Emergency Management but for any information management requirement.

44814 **(UCRL—96378) Design and development of a database for spectral data and analysis results.** Dougan, A.D.; Carlson, J.B.; Manatt, D.R.; Buckley, W.M.; Pochy, R.D. (Lawrence Livermore National Lab., CA (USA); Compuchem, Inc., Hayward, CA (USA)). 15 Apr 1987. Contract W-7405-ENG-48. 5p. (CONF-8704121—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE87011323.

From Ingres User Association meeting; San Francisco, CA, USA (26 Apr 1987).

A data-management system to provide quick access to spectral data and to track chemical parameters and analysis results has been developed. Data are collected at workstations which control stand-alone pulse height analyzers used for gamma, x-ray or alpha counting. The data is electronically transferred to a VAX computer where it is entered into an INGRES database. A set of tools has been developed to allow users easy access to this database. Intergroup transfer of analyzed results is in the form of "transactions," which are modeled after banking transactions.

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The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

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Index entries are selected to indicate the important ideas and concepts presented in a document, rather than words that may appear in the text. Within the available thesaurus terms, the most probable or logical place to look for typical information is selected. "See references" are included to guide users from synonymous terms or phrases to the descriptor selected as a subject heading for the concept (e.g., Pipeline Quality Gas, see HIGH BTU GAS). "See also references" are used to indicate where to find references to subject concepts that are narrower, broader, or related to a particular subject heading. To complete an exhaustive search of a given subject, all such headings should be reviewed. Copies of DOE/TIC-7000, the Subject Thesaurus, are available from the National Technical Information Service (NTIS), U.S. Department of Commerce, Springfield, VA 22161.

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AC05-85CE40741	**Energetics, Inc., Columbia, MD (USA)**	
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AC05-85OR21468	**Shah and Associates, Inc., Gaithersburg, MD (USA)**	
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AC06-65RL01837	**Hanford Environmental Health Foundation, Richland, WA (USA)**	
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AC06-76FF02170	**Hanford Engineering Development Lab., Richland, WA (USA)**	
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AC06-76RL01830	**Pacific Northwest Lab., P.O. Box 999, Richland, WA 99352**	
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AC06-76RL01857	**UNC Nuclear Industries, Inc., Richland, WA (USA)**	
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AC06-77RL01030	**Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations**	
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AC07-76ID01570	**EG and G Idaho, Inc., Idaho Falls (USA)**	
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AC07-81NE44139	**West Valley Nuclear Services Co., Inc., West Valley, NY (USA)**	
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AC07-86ID12584	**UNC Geotech, Grand Junction, CO (USA)**	
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AC07-86ID12647	**Nutech Engineers, Inc., San Jose, CA (USA)**	
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AC07-86ID12651	**NUS Corp., Clearwater, FL (USA)**	
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AC08-85NV10384	**Nevada Univ., Reno (USA). Desert Research Inst.**	
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AC08-86NV10471	**AWC, Inc., Las Vegas, NV (USA)**	
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AC09-76SR00001	**Savannah River Lab., Aiken, SC (USA)**	
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AC21-84LC11049	**Wyoming Univ., Laramie (USA)**	
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AC21-84MC21108	**UCC Research Corp., Bristol, VA (USA)**	
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AC21-85MC22046	**Westinghouse Research and Development Center, Pittsburgh, PA (USA)**	
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AC22-84PC70508	**TRW Space and Technology Group, Redondo Beach, CA (USA)**	
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AC79-83BP11287	**Pacific Power and Light Co., Portland, OR (USA)**	
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AI01-76ET20320	**National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center**	
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AI01-86RW00091	**National Research Council, Washington, DC (USA). Commission on Engineering and Technical Systems**	
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AI03-86SF16310	**National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center**	
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AI79-83BP12659	Montana Dept. of Fish, Wildlife and Parks, Kalispell (USA)	
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AI79-83BP39643	National Marine Fisheries Service, Seattle, WA (USA). Coastal Zone and Estuarine Studies Div.	
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AI79-84BP17608	Forest Service, Portland, OR (USA). Pacific Northwest Forest and Range Experiment Station	
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AS05-76ER03065	Duke Univ., Durham, NC (USA). High Energy Physics Group	
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AS05-76ER03346	Georgia Inst. of Tech., Atlanta (USA). School of Chemistry	
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AS05-76ER04043	Virginia Univ., Charlottesville (USA)	
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FC21-83FE60177	Western Research Inst., Laramie, WY (USA)	
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FC22-83FE60149	National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)	
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FC22-87PC79863	Southern Illinois Univ., Carbondale (USA). Coal Extraction and Utilization Research Center	
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FG01-86CE26566	Pequod Associates, Inc., Boston, MA (USA)	
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FG02-84ER45098	State Univ. of New York, Stony Brook (USA). Dept. of Materials Science and Engineering	
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FG02-84ER45133	Purdue Univ., Lafayette, IN (USA). School of Materials Engineering	
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FG02-86ER45274	Wisconsin Univ., Madison (USA). Dept. of Metallurgical and Mineral Engineering	
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FG02-86ER45282	Cornell Univ., Ithaca, NY (USA)	
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FG02-86ER52127	Illinois Univ., Urbana (USA). Fusion Studies Lab.	
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FG02-86ER60394	Chicago Univ., IL (USA)	
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FG02-86ER60397	East Anglia Univ. (UK). Climatic Research Unit	
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FG02-86ER60487	Univ. of Cincinnati, OH	
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FG02-87ER45285	Arizona Univ., Tucson (USA)	
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FG02-87ER45297	Arizona Univ., Tucson (USA). Dept. of Physics	
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FG03-84ER45093	University of Southern California, Los Angeles (USA)	
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FG03-87ER25028	Stanford Univ., CA (USA). Systems Optimization Lab.	
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FG04-86ER60452	New Mexico Univ., Albuquerque (USA)	
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FG05-80ET53088	Texas Univ., Austin (USA). Inst. for Fusion Studies	
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	Colorado Univ., Boulder (USA). Dept. of Astrophysical, Planetary, and Atmospheric Sciences	
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FG05-83OR21390	Council of Great Lakes Governors, Inc., Madison, WI (USA)	
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FG05-85ER13383	Howard Univ., Washington, DC (USA). Dept. of Chemistry	
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FG05-85ER25010	**Texas Univ., Austin (USA)**	
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FG05-85MI10069	**Atlanta Univ., GA (USA)**	
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FG05-85NE37949	**Auburn Univ., AL (USA). Dept. of Mechanical Engineering**	
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FG05-86ER60393	**Louisiana State Univ., Baton Rouge (USA). Dept. of Zoology and Physiology**	
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FG05-87ER40310	**Texas A and M Univ., College Station (USA). Dept. of Physics**	
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FG05-87ER40314	**Tennessee Technological Univ., Cookeville (USA). Dept. of Physics**	
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FG06-77ET20181	**Alaska Univ., Fairbanks (USA). Geophysical Inst.**	
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FG06-84ER45163	**Simon Fraser Univ., Burnaby, British Columbia (Canada). Dept. of Physics**	
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FG07-84ID12526	**Oregon State Dept. of Geology and Mineral Industries, Portland (USA)**	
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FG21-79ET14692	**Minnesota Dept. of Natural Resources, St. Paul (USA). Div. of Minerals**	
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FG22-85PC80520	**Rochester Univ., NY (USA). Dept. of Chemical Engineering**	
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FG22-85PC80539	**Atlanta Univ. Center, Inc., GA (USA). Dolphus E. Milligan Science Research Inst.**	
	12:43976	DOE/PC/80539—T8
FG22-85PC80910	**Advanced Fuel Research, Inc., East Hartford, CT (USA)**	
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FG22-86PC90527	**Pittsburgh Univ., PA (USA). Dept. of Chemistry**	
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FG22-86PC90528	**Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering**	
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FG22-86PC90533	**Brigham Young Univ., Provo, UT (USA)**	
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FG22-86PC90910	**Pennsylvania State Univ., University Park (USA)**	
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FG79-82BP35474	**Washington State Dept. of Natural Resources, Olympia (USA)**	
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W-31-109-ENG-38	**Chemistry Div., Argonne National Lab., 9700 South Cass Avenue, Argonne, IL 60439**	
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36	NTIS (US Sales Only), PC A02/MF A01		DE87752411	MN -34C	12:44586
BM-RI-					
9062	*See* PB-87-194320/XAB				12:42980
9066	*See* PB-87-194338/XAB				12:42971
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BMI/ONWI-					
645	NTIS, PC A12/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012853	STD -70	12:43044
BNL-					
39768	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012116	MN -28	12:43847
39873	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012489	MN -25	12:43618
39879	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87011295	MN -20	12:44710
39918	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012480	MN -34C	12:44239
39919	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012498	MN -34D	12:44455
39930	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012114	MN -48	12:44198
39982	NTIS, PC A03; 3		DE87012481	MN -34C	12:43899
39985	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013306	MN -4	12:43517
39995	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013304	MN -102	12:42914
40002	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013314	MN -94c	12:43440
40048	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013308	MN -34	12:44629
40058	NTIS, PC A02; 3		DE87013310	MN -37	12:43919
40064	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013307	MN -25	12:43580
BNL-NCS-					
51771-Ed.1-Suppl.3	NTIS, PC A03; 3		DE87013990	STD -34C	12:44500
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39974	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012493	MN -78	12:43335
40049	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013299	MN -80	12:43336
51581-Vol.5	*See* NUREG/CR-2907-Vol.5		TI87013757	MN -11	12:43316
52093	*See* NUREG/CR-4982		TI87013442	MN -78	12:43041
CEA-CONF-					
8329	NTIS (US Sales Only), PC A04/MF A01		DE87752218	MN -34A	12:44414
8554	NTIS (US Sales Only), PC A02/MF A01		DE87752199	MN -34A	12:44415
8678	NTIS (US Sales Only), PC A02/MF A01		DE87752344	MN -34B	12:44240
8688	NTIS (US Sales Only), PC A02/MF A01		DE87752217	MN -23	12:44191
8756	NTIS (US Sales Only), PC A02/MF A01		DE87752345	MN -34B	12:44241
8769	NTIS (US Sales Only), PC A02/MF A01		DE87752362	MN -37	12:43900
8774	NTIS (US Sales Only), PC A03/MF A01		DE87752219	MN -34C	12:44559
8778	NTIS (US Sales Only), PC A02/MF A01		DE87752220	MN -34	12:44609
8786	NTIS (US Sales Only), PC A02/MF A01		DE87752346	MN -34B	12:44242
8787	NTIS (US Sales Only), PC A02/MF A01		DE87752347	MN -34B	12:44243
8788	NTIS (US Sales Only), PC A02/MF A01		DE87752348	MN -34B	12:44244
8789	NTIS (US Sales Only), PC A02/MF A01		DE87752349	MN -34B	12:44245
8790	NTIS (US Sales Only), PC A02/MF A01		DE87752350	MN -34B	12:44246
8791	NTIS (US Sales Only), PC A02/MF A01		DE87752351	MN -34B	12:44247
8792	NTIS (US Sales Only), PC A02/MF A01		DE87752352	MN -34B	12:44248
8793	NTIS (US Sales Only), PC A06/MF A01		DE87752221	MN -79	12:43267
8794	NTIS (US Sales Only), PC A02/MF A01		DE87752222	MN -32	12:44772
8795	NTIS (US Sales Only), PC A02/MF A01		DE87752223	MN -79	12:43337
8796	NTIS (US Sales Only), PC A02/MF A01		DE87752224	MN -79	12:43268
8838	NTIS (US Sales Only), PC A02/MF A01		DE87752225	MN -86	12:43034
8839	NTIS (US Sales Only), PC A02/MF A01		DE87752226	MN -86	12:43035
8847	NTIS (US Sales Only), PC A02/MF A01		DE87752227	MN -86	12:43036
CEA-DRNR-P-					
330	*See* CEA-CONF-8793		DE87752221	MN -79	12:43267
331	*See* CEA-CONF-8794		DE87752222	MN -32	12:44772
332	*See* CEA-CONF-8795		DE87752223	MN -79	12:43337
335	*See* CEA-CONF-8796		DE87752224	MN -79	12:43268
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2493	NTIS (US Sales Only), PC A11/MF A01		DE87752204	MN -32	12:44773
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5369	NTIS (US Sales Only), PC A04/MF A01			MN -20f	12:44640
5374	NTIS (US Sales Only), PC A04/MF A01		DE87752205	MN -25	12:43518
5378	NTIS (US Sales Only), PC A08/MF A01		DE87752206	MN -11	12:44023
CEA-SPhT-					
86-141	*See* CEA-CONF-8774		DE87752219	MN -34C	12:44559
CEBAF-PR-					
87-020	*See* DOE/ER/40150-33	E 1.99:	DE87012467	MN -34C	12:44561
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87-002	*See* DOE/ER/40150-30	E 1.99:	DE87012465	MN -34A	12:44419
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8	*See* AD-B-020287/9/XAB				12:43939
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7821	*See* AD-A-180792/4/XAB				12:43178
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7-AO-1-56(EX)	*See* AD-A-995487/6/XAB				12:43956
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8514	*See* PB-87-197661/XAB				12:42978
CONF-8210353-	(Seminar on uranium deposits spatially related to discordances, Nancy-Brabois, France, 26-28 Oct 1982)				
	See CREGU-1		DE87752247	MN -51	12:43013
CONF-8410470-	(8. conference on steam turbines of large output, Karlovy Very, Czechoslovakia, 30 Oct-2 Nov 1984)				
Pt.1	*See* INIS-mf-10936		DE87702597	MN -80	12:43291
CONF-8502154-	(Meeting on hadron spectroscopy, Oho, Japan, 5-6 Feb 1985)				
	See KEK-85-14		DE87780150	MN -34D	12:44465

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CONF-8505358-	(13. Czechoslovak seminar on plasma physics and technology, Liblice, Czechoslovakia, 13-15 May 1985)				
	See IPPCZ-253		DE87702604	MN -20	12:44662
CONF-850629-	(International conference on analytical chemistry in nuclear technology, Karlsruhe, F.R. Germany, 4-7 Jun 1985)				
15	*See* ND-R-1266(D)		TI87900940	ND -86	12:43033
CONF-8506204-	(Workshop on tests of electroweak theories, polarized processes and other phenomena, Trieste, Italy, 10-12 Jun 1985)				
3	*See* SLAC-PUB-3774	E 1.99:	DE87012319	MN -28	12:43823
CONF-8507155-	(Specialist research meetings on nuclear science information, Kumatori, Japan, 22 Jul 1985)				
	See KURRI-TR-274		DE87780151	MN -2	12:44809
CONF-850824-	(5. international seminar on mathematical and mechanical modelling of reactor fuel elements, Harwell, Oxfordshire, UK, 15-16 Aug 1985)				
	Nucl. Eng. Des., 101: No. 3, 233-247(May 1987)				12:43248
CONF-8508212-	(19. annual meeting of the European Society for Radiation Biology, Prague, Czechoslovakia, 26-30 Aug 1985)				
Absts.	*See* INIS-mf-10937		DE87702598	MN -48	12:44203
CONF-8508241-	(8. workshop on nuclear physics, Sao Lourenco, MG, Brazil, 31 Aug-4 Sep 1985)				
	See INIS-BR-712		DE87703464	MN -34C	12:44563
CONF-8509387-	(13. summer school on quantum optics, Frombork, Poland, 2-8 Sep 1985)				
1	*See* CEA-CONF-8329		DE87752218	MN -34A	12:44414
CONF-851011-	(4. symposium on separation science and technology for energy applications, Knoxville, TN, USA, 20-24 Oct 1985)				
	See Sci. Technol., 22: No. 2/3, 873-887(1987)				12:43665
CONF-8510447-	(Status seminar on the R and D project Hope, Braunschweig, F.R. Germany, 31 Oct 1985)				
	See GSF-20/86		DE87780171	MN -70	12:43077
CONF-8512120-	(International Atomic Energy Agency technical committee on utilization of thorium-based nuclear fuel: current status and perspectives, Vienna, Austria, 2-4 Dec 1985)				
	See IAEA-TECDOC-412		DE87702566	MN -80	12:43305
CONF-8512129-	(4. congress of scientific and technological engineering, Sao Carlos, Brazil, 1 Dec 1985)				
1-Summ.	*See* INIS-BR-672		DE87702594	MN -4	12:43588
CONF-8512135-	(Advances in technology for the construction of deep-underground facilities conference, Reston, VA, USA, 12-14 Dec 1985)				
	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87009067	MN -38	12:43810
CONF-8512138-	(4. congress of the Baden-Wuerttemberg government on the future of ecology, economy, and society, Stuttgart, F.R. Germany, 17-18 Dec 1985)				
	NTIS (US Sales Only), PC A18; 3		DE87752963	MN -11	12:44178
CONF-860102-	(3. symposium on space nuclear power systems, Albuquerque, NM, USA, 13-16 Jan 1986)				
16	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86007517	MN -80	12:43321
CONF-860150-	(Winter condensed matter physics conference: frontiers in condensed matter X-ray physics, Aspen, CO, USA, 12-18 Jan 1986)				
9	*See* BNL-39918	E 1.99:	DE87012480	MN -34C	12:44239
CONF-8603207-	(Double layers in astrophysics conference, Huntsville, AL, USA, 17 Mar 1986)				
	See N-87-23313				12:44391
CONF-8604297-	(6. international workshop on expert systems and their applications, Avignon, France, 28-30 Apr 1986)				
2	*See* CEA-CONF-8794		DE87752222	MN -32	12:44772
CONF-8604317-	(Interregional training course on processing of nuclear data for nuclear reactor applications, Bombay, India, 21-25 Apr 1986)				
1	*See* CEA-CONF-8793		DE87752221	MN -79	12:43267
CONF-8604346-	(Structural dynamics and control interaction of flexible structures, Huntsville, AL, USA, 22 Apr 1986)				
Pt.2	*See* N-87-22729				12:43735
CONF-860501-	(Conference on the science and technology of fast reactor safety, Channel Islands, UK, 12-16 May 1986)				
21	*See* CEA-CONF-8795		DE87752223	MN -79	12:43337
22	*See* CEA-CONF-8796		DE87752224	MN -79	12:43268
CONF-8605207-	(9. Sitges conference, Sitges, Spain, 26-30 May 1986)				
2	*See* CEA-CONF-8778		DE87752220	MN -34	12:44609
CONF-860618-	(REmote FLuvial EXperiments (REFLEX) in arid lands - predictive modeling seminar, Page, AZ, USA, 9-11 Jun 1986)				
Summs.	*See* DOE/ER-0321	E 1.99:	DE87012368	MN -11	12:44102

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CONF-8606145-	(26. Committee on Space Research meeting, Toulouse, France, 30 Jun-12 Jul 1986)				
11	*See* CEA-CONF-8678		DE87752344	MN -34B	12:44240
CONF-8606186-	(Symposium on the role of alpha particles in magnetically confined fusion plasmas, Goteborg, Sweden, 24-27 Jun 1986)				
4	*See* PPPL-2443	E 1.99:	DE87013202	STD -20a	12:44693
Summ.	*See* CTH-IEFT/PP-1986-13		DE87752430	MN -20	12:44645
CONF-8606294-	(26. Kracow school on theoretical physics, Zakopane, Poland, 1-13 Jun 1986)				
2	*See* CEA-CONF-8774		DE87752219	MN -34C	12:44559
CONF-8606333-	(Conference on rotordynamic instability problems in high-performance turbomachinery, College Station, TX, USA, 2 Jun 1986)				
	See N-87-22199				12:43732
CONF-860701-	(23. international conference on high-energy physics, Berkeley, CA, USA, 16-23 Jul 1986)				
84	*See* LAL-86-28		DE87752230	MN -34D	12:44494
CONF-860753-	(International conference on EXAFS and near edge structure, Saumur, France, 7-11 Jul 1986)				
9	*See* DOE/ER/45163-8	E 1.99:	DE87011827	MN -34A	12:43527
10	*See* DOE/ER/45163-9	E 1.99:	DE87011828	MN -34	12:43528
CONF-860793-	(2. IAP meeting on nuclear astrophysics, Paris, France, 7-11 Jul 1986)				
5	*See* CEA-CONF-8786		DE87752346	MN -34B	12:44242
6	*See* CEA-CONF-8787		DE87752347	MN -34B	12:44243
7	*See* CEA-CONF-8788		DE87752348	MN -34B	12:44244
8	*See* CEA-CONF-8789		DE87752349	MN -34B	12:44245
9	*See* CEA-CONF-8790		DE87752350	MN -34B	12:44246
10	*See* CEA-CONF-8791		DE87752351	MN -34B	12:44247
11	*See* CEA-CONF-8792		DE87752352	MN -34B	12:44248
CONF-8607330-	(2. international microwave symposium, Rio De Janeiro, Brazil, 27-30 Jul 1986)				
1	*See* UCRL-95843	E 1.99:	DE87011308	MN -38	12:43739
CONF-860807-	(6. international workshop on inelastic ion surface collisions, Argonne, IL, USA, 25-29 Aug 1986)				
4	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011464	MN -34A	12:43920
CONF-860848-	(National conference on artificial intelligence, Philadelphia, PA, USA, 11-15 Aug 1986)				
5	*See* UCRL-94424	E 1.99:	DE87011565	MN -37	12:43660
CONF-8608125-	(American Statistical Association meeting, Chicago, IL, USA, 18-21 Aug 1986)				
4	*See* LA-UR-86-556	E 1.99:	DE87013293	MN -70	12:44227
CONF-8608169-	(14. international cancer congress, Budapest, Hungary, 21-27 Aug 1986)				
Vols.2,3-Absts.	*See* INIS-mf-10916		DE87702596	MN -48	12:44187
CONF-8608174-	(Workshop on economic feasibility of food irradiation applications, Wageningen, Netherlands, 25 Aug-5 Sep 1986)				
3	*See* CEA-CONF-8688		DE87752217	MN -23	12:44191
CONF-8608180-	(TAU symposium on globular cluster systems in galaxies, Cambridge, MA, USA, 25-29 Aug 1986)				
1	*See* CEA-CONF-8756		DE87752345	MN -34B	12:44241
CONF-8608186-	(20. international cosmic ray conference, Moscow, USSR, 2-15 Aug 1986)				
1	*See* ANL-HEP-CP-87-47	E 1.99:	DE87011354	MN -37	12:44238
CONF-860911-	(192. American Chemical Society national meeting, Anaheim, CA, USA, 7-12 Sep 1986)				
	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 31: No. 4, 1-4(Sep 1986)				12:42925
	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 31: No. 4, 24-31(Sep 1986)				12:42926
	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 31: No. 4, 32-38(Sep 1986)				12:42927
	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 31: No. 4, 43-55(Sep 1986)				12:42928
	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 31: No. 4, 56-63(Sep 1986)				12:42929
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	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 31: No. 4, 181-191(Sep 1986)				12:42934
	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 31: No. 4, 208-215(Sep 1986)				12:42935
	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 31: No. 4, 216-226(Sep 1986)				12:42936
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	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 31: No. 4, 233-239(Sep 1986)			12:42938
	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 31: No. 4, 240-250(Sep 1986)			12:42939
	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 31: No. 4, 257-267(Sep 1986)			12:42940
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	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 31: No. 4, 251-256(Sep 1986)			12:43688
CONF-860917-	(14. SOFT - symposium on fusion technology, Avignon, France, 8-12 Sep 1986)			
22	*See* SAND-87-1688C	DE87012128	MN -20c	12:44741
CONF-860921-	(ISEC '86: international solvent extraction conference, Munich, F.R. Germany, 11-16 Sep 1986)			
9	*See* CEA-CONF-8838	DE87752225	MN -86	12:43034
10	*See* CEA-CONF-8839	DE87752226	MN -86	12:43035
CONF-8609132-	(Resonance ionization spectroscopy and its application, Swansea, UK, 7-12 Sep 1986)			
15-Summ.	*See* CEA-CONF-8554	DE87752199	MN -34A	12:44415
CONF-8609159-	(International school-seminar on heavy ion physics, Dubna, USSR, 23-30 Sep 1986)			
7	*See* GANIL-P-86-25	DE87752356	MN -34C	12:44530
8	*See* GANIL-P-86-26	DE87752357	MN -34C	12:44537
CONF-8609277-	(Gesellschaft Deutscher Chemiker congress, Regensburg, F.R. Germany, 29 Sep-2 Oct 1986)			
1	*See* CEA-CONF-8847	DE87752227	MN -86	12:43036
CONF-8609318-	(Conference on transonic and supersonic phenomena in turbomachines, Munich, F.R. Germany, 10 Sep 1986)			
	See AGARD-CP-01			12:43769
CONF-861038-	(OSA/APS international laser science conference, Seattle, WA, USA, 20-24 Oct 1986)			
10	*See* UCRL-94675	E 1.99: DE87011878	MN -38	12:43738
CONF-861062-	(European wind energy conference, Rome, Italy, 7-9 Oct 1986)			
8	*See* THE-R-812-D		ND -60	12:43200
9	*See* THE-R-818-D		ND -60	12:43195
10	*See* THE-R-816-D		ND -60	12:43202
11	*See* THE-R-815-D		ND -60	12:43201
12	*See* THE-R-817-D		ND -60	12:43203
CONF-861076-	(Fall meeting of the Metallurgical Society of AIME, Orlando, FL, USA, 5-9 Oct 1986)			
8	*See* DOE/NASA/16310-4	E 1.99: DE87013853	STD -25	12:43534
CONF-8610108-	(2. joint US/CERN school on particle accelerators: frontiers of particle beams, South Padre Island, TX, USA, 23-29 Oct 1986)			
1	*See* DOE/ER/40150-34	E 1.99: DE87012463	MN -28	12:43832
2	*See* SLAC-PUB-4320	E 1.99: DE87012835	MN -28	12:43839
CONF-8610183-	(20. LAMPF Users Group meeting, Los Alamos, NM, USA, 27-28 Oct 1986)			
	See LA-10956-C	E 1.99: DE87012707	STD -34	12:44514
CONF-8610208-	(Workshop on nonlinear optical techniques for SDI applications, Albuquerque, NM, USA, 28-31 Oct 1986)			
2	*See* UCRL-95611	E 1.99: DE87012661	MN -38	12:43759
CONF-8610275-	(National colloquium on covering gate array and standard cell techniques, Grenoble, France, 23-24 Oct 1986)			
1	*See* CEA-CONF-8769	DE87752362	MN -37	12:43900
CONF-8610316-	(CSR symposium and exhibition concerning the planning and protection of the human environment, Duesseldorf, F.R. Germany, 1-3 Oct 1986)			
	NTIS (US Sales Only), PC A99; 3	DE87752961	MN -11	12:43405

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CONF-861114-	(9. international conference on application of accelerators in research and industry, Denton, TX, USA, 10-12 Nov 1986)			
	Nucl. Instrum. Methods Phys. Res., Sect. A., 24/25: No. 2, 698-700(Apr 1987)			12:43663
	Nucl. Instrum. Methods Phys. Res., Sect. A., 24/25: No. 2, 1006-1009(Apr 1987)			12:43664
	Nucl. Instrum. Methods Phys. Res., Sect. A., 24/25: No. 1, 373-376(Apr 1987)			12:43766
	Nucl. Instrum. Methods Phys. Res., Sect. A., 24/25: No. 2, 725-729(Apr 1987)			12:43828
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	Nucl. Instrum. Methods Phys. Res., Sect. A., 24/25: No. 2, 852-854(Apr 1987)			12:43884
	Nucl. Instrum. Methods Phys. Res., Sect. A., 24/25: No. 2, 855-857(Apr 1987)			12:43885
	Nucl. Instrum. Methods Phys. Res., Sect. A., 24/25: No. 2, 897-900(Apr 1987)			12:43886
	Nucl. Instrum. Methods Phys. Res., Sect. A., 24/25: No. 2, 905-908(Apr 1987)			12:43887
	Nucl. Instrum. Methods Phys. Res., Sect. A., 24/25: No. 2, 925-927(Apr 1987)			12:43888
	Nucl. Instrum. Methods Phys. Res., Sect. A., 24/25: No. 2, 937-943(Apr 1987)			12:43889
	Nucl. Instrum. Methods Phys. Res., Sect. A., 24/25: No. 2, 963-966(Apr 1987)			12:43890
	Nucl. Instrum. Methods Phys. Res., Sect. A., 24/25: No. 1, 38-42(Apr 1987)			12:43891
	Nucl. Instrum. Methods Phys. Res., Sect. A., 24/25: No. 1, 381-390(Apr 1987)			12:43892
	Nucl. Instrum. Methods Phys. Res., Sect. A., 24/25: No. 1, 391-396(Apr 1987)			12:43893
	Nucl. Instrum. Methods Phys. Res., Sect. A., 24/25: No. 1, 490-492(Apr 1987)			12:43894
	Nucl. Instrum. Methods Phys. Res., Sect. A., 24/25: No. 2, 672-675(Apr 1987)			12:43909
	Nucl. Instrum. Methods Phys. Res., Sect. A., 24/25: No. 2, 695-697(Apr 1987)			12:43910
	Nucl. Instrum. Methods Phys. Res., Sect. A., 24/25: No. 1, 59-63(Apr 1987)			12:43911
	Nucl. Instrum. Methods Phys. Res., Sect. A., 24/25: No. 1, 437-441(Apr 1987)			12:43912
	Nucl. Instrum. Methods Phys. Res., Sect. A., 24/25: No. 1, 447-453(Apr 1987)			12:43913
	Nucl. Instrum. Methods Phys. Res., Sect. A., 24/25: No. 2, 1063-1067(Apr 1987)			12:44188
	Nucl. Instrum. Methods Phys. Res., Sect. A., 24/25: No. 1, 1-2(Apr 1987)			12:44434
	Nucl. Instrum. Methods Phys. Res., Sect. A., 24/25: No. 1, 3-10(Apr 1987)			12:44435
	Nucl. Instrum. Methods Phys. Res., Sect. A., 24/25: No. 1, 101-105(Apr 1987)			12:44436
	Nucl. Instrum. Methods Phys. Res., Sect. A., 24/25: No. 1, 209-213(Apr 1987)			12:44437
	Nucl. Instrum. Methods Phys. Res., Sect. A., 24/25: No. 1, 214-218(Apr 1987)			12:44438
	Nucl. Instrum. Methods Phys. Res., Sect. A., 24/25: No. 1, 256-260(Apr 1987)			12:44439
	Nucl. Instrum. Methods Phys. Res., Sect. A., 24/25: No. 1, 284-287(Apr 1987)			12:44440
	Nucl. Instrum. Methods Phys. Res., Sect. A., 24/25: No. 1, 316-320(Apr 1987)			12:44441
	Nucl. Instrum. Methods Phys. Res., Sect. A., 24/25: No. 1, 325-328(Apr 1987)			12:44442
	Nucl. Instrum. Methods Phys. Res., Sect. A., 24/25: No. 1, 335-338(Apr 1987)			12:44605
	Nucl. Instrum. Methods Phys. Res., Sect. A., 24/25: No. 2, 1050-1053(Apr 1987)			12:44608
	Nucl. Instrum. Methods Phys. Res., Sect. A., 24/25: No. 1, 139-142(Apr 1987)			12:44626
	Nucl. Instrum. Methods Phys. Res., Sect. A., 24/25: No. 1, 147-152(Apr 1987)			12:44627
	Nucl. Instrum. Methods Phys. Res., Sect. A., 24/25: No. 1, 397-399(Apr 1987)			12:44628

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CONF-8611185-	(Silicon material research symposium, Hsin-Chu, Taiwan, 28-29 Nov 1986)				
1	*See* SAND-87-1883C	E 1.99:	DE87013809	MN -25	12:43634
CONF-861207-	(Materials Research Society fall meeting, Boston, MA, USA, 1-5 Dec 1986)				
113	*See* N-87-23304				12:43632
CONF-861285-	(National executive management seminar on industrial radiation curing technology, Kuala Lumpur, Malaysia, 8-10 Dec 1986)				
	See PPA/SS-10		DE87780152	MN -23	12:43701
CONF-861294-	(Chemistry department faculty/graduate students seminar, Clemson, SC, USA, 4 Dec 1986)				
1-Vugraphs	*See* DP-MS-86-190	E 1.99:	DE87010166	MN -10	12:43037
CONF-870132-	(OE/LASE '87, Los Angeles, CA, USA, 11-16 Jan 1987)				
13	*See* UCRL-95733	E 1.99:	DE87011322	MN -21	12:44742
16	*See* UCRL-95849		DE87012914	MN -21	12:43761
CONF-870163-	(DOE/CEC workshop on mechanisms of radiation interaction with DNA, San Diego, CA, USA, 21 Jan 1987)				
2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012536	MN -48	12:44199
CONF-870170-	(Workshop on a linear-collider B anti B factory, Los Angeles, CA, USA, 26-30 Jan 1987)				
2	*See* ANL-HEP-CP-87-44	E 1.99:	DE87011475	MN -28	12:43846
CONF-870182-	(8. winter meeting on low temperature physics, Cuernavaca, Mexico, 18-20 Jan 1987)				
1	*See* DOE/ER/45297-2	E 1.99:	DE87012725	MN -25	12:43532
CONF-870183-	(2. simulation fidelity workshop, White Oak, MD, USA, 27-29 Jan 1987)				
1	*See* SAND-86-2268C	E 1.99:	DE87013069	MN -37	12:43908
CONF-870249-	(Computing high energy physics, Pacific Grove, CA, USA, 2-6 Feb 1987)				
9	*See* SLAC-PUB-4345	E 1.99:	DE87012317	MN -32	12:44792
CONF-870260-	(International workshop hadron facility technology, Santa Fe, NM, USA, 2-5 Feb 1987)				
5	*See* TRI-PP-87-10		DE87900857	MN -28	12:43840
6	*See* TRI-PP-87-8		DE87900855	MN -28	12:43825
7	*See* TRI-PP-87-16		DE87900863	MN -28	12:43841
8	*See* TRI-PP-87-15		DE87900862	MN -28	12:43895
9	*See* TRI-PP-87-11		DE87900858	MN -28	12:43866
10	*See* TRI-PP-87-13		DE87900860	MN -28	12:43868
11	*See* TRI-PP-87-12		DE87900859	MN -28	12:43867
12	*See* TRI-PP-87-14		DE87900861	MN -28	12:43869
13	*See* LA-UR-87-2321	E 1.99:	DE87013151	MN -28	12:43834
CONF-870272-	(American Institute of Metallurgical Engineers annual meeting: light metals session, Denver, CO, USA, 22-26 Feb 1987)				
6	*See* LBL-22837	E 1.99:	DE87012881	MN -25	12:43546
CONF-870276-	(3. Brazilian school of semiconductor physics, Campinas, Brazil, 16-20 Feb 1987)				
2	*See* LBL-23492	E 1.99:	DE87014120	MN -25	12:43629
CONF-870279-	(Lake Louise winter institute, Alberta, Canada, 15-21 Feb 1987)				
10	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87011488	MN -34D	12:44456
CONF-870283-	(BNL neutrino workshop, Upton, NY, USA, 5-7 Feb 1987)				
11	*See* BNL-39919	E 1.99:	DE87012498	MN -34D	12:44455
12	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013464	MN -34D	12:43831
CONF-8702102-	(Deep probe sampling design and planning workshop, Augusta, GA, USA, 17-18 Feb 1987)				
Summ.	*See* DOE/ER-0320	E 1.99:	DE87012324	MN -11	12:44216
CONF-8702104-	(Environmental issues conference, Santa Fe, NM, USA, 26-27 Feb 1987)				
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011489	MN -70	12:43049
CONF-870302-	(Particle accelerator conference, Washington, DC, USA, 16-19 Mar 1987)				
203	*See* LBL-22236	E 1.99:	DE87011093	MN -28	12:43857
208	*See* ANL-HEP-CP-87-18		DE87011510	MN -28	12:43843
220	NTIS, PC A02; 3		DE87011497	MN -28	12:43816
221	*See* ANL-HEP-CP-87-28		DE87011508	MN -28	12:43845
223	*See* TRI-PP-87-38		DE87900877	MN -28	12:43880
224	*See* TRI-PP-87-37		DE87900876	MN -28	12:43879
225	*See* ANL-HEP-CP-87-19		DE87011538	MN -28	12:43844
226	NTIS, PC A02; 3		DE87011536	MN -28	12:43848
227	*See* TRI-PP-87-32		DE87900871	MN -28	12:43874
228	*See* TRI-PP-87-33		DE87900872	MN -28	12:43875
229	*See* TRI-PP-87-34		DE87900873	MN -28	12:43876
230	*See* TRI-PP-87-35		DE87900874	MN -28	12:43877
231	*See* TRI-PP-87-36		DE87900875	MN -28	12:43878
233	*See* TRI-PP-87-27		DE87900866	MN -28	12:43870
234	*See* TRI-PP-87-28		DE87900867	MN -28	12:43871
235	*See* TRI-PP-87-29		DE87900868	MN -28	12:43872
236	*See* TRI-PP-87-30		DE87900869	MN -28	12:43842
237	*See* TRI-PP-87-31		DE87900870	MN -28	12:43873

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238	NTIS, PC A02; 3		DE87011520	MN -28	12:43849
240	*See* TRI-PP-87-25		DE87900864	MN -28	12:43826
242	*See* SLAC-PUB-4091	E 1.99:	DE87012841	MN -28	12:43824
243	*See* SLAC-PUB-4278	E 1.99:	DE87012838	MN -28	12:43838
244	*See* SLAC-PUB-4227	E 1.99:	DE87012839	MN -28	12:43837
CONF-870306-	(Waste management '87, Tucson, AZ, USA, 1-5 Mar 1987)				
63	*See* DP-MS-86-213	E 1.99:	DE87013044	MN -70	12:43056
CONF-870324-	(12. international conference on slurry technology, New Orleans, LA, USA, 30 Mar-3 Apr 1987)				
1	NTIS, PC A02; 3		DE87011519	MN -96	12:43505
CONF-870364-	(Energy from biomass and wastes, Orlando, FL, USA, 16-20 Mar 1987)				
3	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011535	MN -61	12:43145
CONF-870396-	(Lunar and planetary science conference, Houston, TX, USA, 16-20 Mar 1987)				
2	*See* UCRL-96724		DE87010810	MN -11	12:44053
CONF-8703143-	(Workshop on superstrings, composite structures, and cosmology, College Park, MD, USA, 11-18 Mar 1987)				
3	*See* SLAC-PUB-4325		DE87013584	MN -34D	12:44498
CONF-8703149-	(Workshop on low emittance beams, Upton, NY, USA, 1 Mar 1987)				
1	*See* LA-UR-87-2118	E 1.99:	DE87011750	MN -28	12:43757
2	*See* LA-UR-87-2155	E 1.99:	DE87011738	MN -28	12:43856
3	*See* SLAC-PUB-4329	E 1.99:	DE87012833	MN -28	12:43865
CONF-8703161-	(Workshop on cryogenic detectors, Munich, F.R. Germany, 13 Mar 1987)				
1	*See* LBL-23468	E 1.99:	DE87012886	MN -34	12:43731
CONF-8703171-	(BWEA annual conference, Edinburgh, UK, 31 Mar-3 Apr 1987)				
1	*See* ECN-87-053			ND -60	12:43198
CONF-870410-	(193. national meeting of the American Chemical Society, Denver, CO, USA, 5-10 Apr 1987)				
	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 32: No. 2, 257-263(Apr 1987)				12:43132
	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 32: No. 2, 186-194(Apr 1987)				12:43133
	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 32: No. 2, 223-228(Apr 1987)				12:43167
14-Rev.	*See* BNL-39873	E 1.99:	DE87012489	MN -25	12:43618
35	*See* LBL-23476	E 1.99:	DE87011377	MN -34C	12:44534
CONF-870413-	(11. international conference on particles and nuclei, Kyoto, Japan, 20-24 Apr 1987)				
4	*See* LA-UR-87-2078	E 1.99:	DE87011767	MN -34A	12:44425
6	*See* DOE/ER/40150-33	E 1.99:	DE87012467	MN -34C	12:44561
CONF-870418-	(Topical meeting on anticipated and abnormal transients in nuclear power plants, Atlanta, GA, USA, 12-15 Apr 1987)				
8	NTIS, PC A02; 3		DE87011530	MN -79	12:43269
CONF-870422-	(89. annual meeting of the American Ceramic Society, Pittsburgh, PA, USA, 26-30 Apr 1987)				
7	*See* HEDL-SA-3677		DE87009971	MN -79h	12:43623
8	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011534	MN -25	12:43581
CONF-870424-	(American Nuclear Society international meeting on advances in reactor physics, mathematics and computation, Paris, France, 27-30 Apr 1987)				
9-FP	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011528	MN -79	12:43322
CONF-870430-	(International conference on methods and applications of radioanalytical chemistry, Kona, HI, USA, 5-10 Apr 1987)				
12	*See* PNL-SA-14250	E 1.99:	DE87011139	MN -11	12:44031
CONF-870438-	(Spring meeting of the Materials Research Society, Anaheim, CA, USA, 21-25 Apr 1987)				
33	*See* SAND-87-1213C	E 1.99:	DE87014171	MN -25	12:43633
CONF-870457-	(Annual meeting of Fusion Power Associates, Pleasanton, CA, USA, 8-9 Apr 1987)				
3	*See* LBL-23326	E 1.99:	DE87010988	MN -21	12:44733
CONF-8704110-	(5. geothermal program review, Washington, DC, USA, 14-15 Apr 1987)				
13	*See* SAND-87-0923C		DE87013083	MN -66a	12:43189
CONF-8704118-	(TIBER meetings, Livermore, CA, USA, 6-8 Apr 1987)				
5-Vugraphs	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87009674	MN -20	12:44712
CONF-8704121-	(Ingres User Association meeting, San Francisco, CA, USA, 26-29 Apr 1987)				
2	*See* UCRL-96378	E 1.99:	DE87011323	MN -32	12:44814
CONF-8704165-	(Cray User Group spring meeting, New York City, NY, USA, 21-25 Apr 1987)				
2	*See* LA-UR-87-2187	E 1.99:	DE87011735	MN -32	12:44810
CONF-8704167-	(Conference on computer aided design/computer aided manufacturing databases 1987: users take charge, San Francisco, CA, USA, 6-7 Apr 1987)				
1	*See* UCRL-96282	E 1.99:	DE87011920	MN -32	12:44799

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CONF-8704170-	(International conference on plasma physics, Kiev, USSR, 6-12 Apr 1987)			
1	*See* UCRL-96829	E 1.99: DE87011571	MN -20f	12:44697
CONF-8704186-	(DOE/industry advanced research and development sensor working group members meeting, Chicago, IL, USA, 30 Apr 1987)			
	NTIS, PC A10/MF A01; 1 (GPO Dep.)	E 1.99: DE87013939	STD -95f	12:43473
CONF-870505-	(32. international gas turbine conference and exhibition, Anaheim, CA, USA, 31 May-4 Jun 1987)			
4	NTIS, PC A02; 3	DE87004614	MN -114	12:43519
5	*See* N-87-22959			12:43807
CONF-870511-	(4. international hazardous waste symposium on environmental aspects of stabilization-solidification of hazardous and radioactive wastes, Atlanta, GA, USA, 3-6 May 1987)			
1	*See* PNL-SA-14908	E 1.99: DE87011993	MN -70B	12:43089
2	*See* ECN-87-089		ND -105	12:42967
3	*See* ECN-87-093		ND -107	12:42968
CONF-870517-	(14. biennial lignite symposium on the technology and utilization of low-rank coals, Dallas, TX, USA, 19-21 May 1987)			
	See DOE/METC-87/6081	E 1.99: DE87012948	MN -101	12:42913
CONF-870519-	(9. annual meeting of the European Safeguards Research and Development Association: safeguards and nuclear material management, London, UK, 12-14 May 1987)			
8	*See* Y/DG-18700	DE87011803	MN -32	12:43285
9	*See* UCRL-95626	DE87013560	MN -16	12:43114
CONF-870528-	(19. IEEE photovoltaic specialists conference, New Orleans, LA, USA, 4-8 May 1987)			
18	*See* N-87-22098			12:43158
CONF-870533-	(11. Canadian congress of applied mechanics, Edmonton, Canada, 31 May-4 Jun 1987)			
4	*See* UCRL-95340	E 1.99: DE87013105	MN -25	12:43637
CONF-870538-	(34. international technical communication conference, Denver, CO, USA, 10-13 May 1987)			
3-FP	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011417	MN -13	12:44751
CONF-870543-	(2. workshop on experiments and detectors for relativistic heavy ion collider, Berkeley, CA, USA, 25-29 May 1987)			
3	*See* UCRL-97153	E 1.99: DE87013795	MN -34C	12:44569
CONF-870552-	(5. conference on real-time computer applications in nuclear, particle, and plasma physics, San Francisco, CA, USA, 11-15 May 1987)			
22	NTIS, PC A02; 3	DE87011453	MN -32	12:44774
CONF-870558-	(19. international electric propulsion conference, Colorado Springs, CO, USA, 11-13 May 1987)			
1	*See* DOE/ET/51013-223	E 1.99: DE87011038	MN -20	12:44714
2	*See* LA-UR-87-2003	E 1.99: DE87011775	MN -80	12:43274
CONF-870560-	(171. Electrochemical Society meeting, Philadelphia, PA, USA, 10-15 May 1987)			
2	NTIS, PC A02; 3	DE87011423	MN -34	12:44610
5	*See* BNL-40002	E 1.99: DE87013314	MN -94c	12:43440
CONF-870564-	(Socioeconomic energy research and analysis conference, Washington, DC, USA, 21-22 May 1987)			
3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011435	MN -98G	12:43401
CONF-870570-	(7. topical conference on applications of radio-frequency power to plasmas, Kissimmee, FL, USA, 4-6 May 1987)			
11	NTIS, PC A02; 3	DE87010015	MN -20a	12:44711
20	*See* GA-A-18853	E 1.99: DE87012298	MN -20	12:44716
21	*See* GA-A-18855	E 1.99: DE87012023	MN -20a	12:44656
CONF-870584-	(Technical symposium southeast on optics, electro-optics and sensors, Orlando, FL, USA, 17-22 May 1987)			
9	*See* UCRL-96803	DE87012632	MN -4	12:43949
10	*See* UCRL-96076	DE87007322	MN -38	12:43712
CONF-8705120-	(NATO advanced workshop on narrow band phenomena, Staverden, Netherlands, 31 May-5 Jun 1987)			
2	*See* LA-UR-87-1611	E 1.99: DE87010116	MN -34	12:43673
CONF-8705146-	(International symposium on muon catalyzed fusion, MCF-87, Leningrad, USSR, 26-29 May 1987)			
2	*See* BNL-39879	E 1.99: DE87011295	MN -20	12:44710
CONF-8705147-	(Piecing the puzzle together: a conference on integrating data for decisionmaking, Washington, DC, USA, 27-29 May 1987)			
3	*See* LBL-23601	E 1.99: DE87012880	MN -32	12:44812
CONF-8705159-	(JANNAF Safety and Environmental Protection subcommittee meeting, Cleveland, OH, USA, 5-7 May 1987)			
1	NTIS, PC A02; 3	DE87011454	MN -11	12:44038
CONF-8705163-	(From colliders to supercolliders workshop, Madison, WI, USA, 11-22 May 1987)			
4	*See* FNAL/C-87/109-E	E 1.99: DE87013566	MN -34C	12:44459

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CONF-8705165-	(Workshop on intermediate voltage microscopy and its application to materials science, Ottawa, Canada, 26-27 May 1987)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011457	MN -34A	12:43921
CONF-8705169-	(Nuclear science and engineering conference, Paris, France, 1 May 1987)			
1	*See* UCRL-95895	E 1.99: DE87013221	MN -34C	12:44603
CONF-8705170-	(Annual PG and E riparian vegetation conference, San Ramon, CA, USA, 11 May 1987)			
1	*See* UCRL-96914	E 1.99: DE87012904	MN -48	12:43165
CONF-8705171-	(Tri-service corrosion conference, Coloarado Springs, CO, USA, 5-7 May 1987)			
1	*See* BNL-39985	E 1.99: DE87013306	MN -4	12:43517
CONF-870601-	(Annual meeting of the American Nuclear Society, Dallas, TX, USA, 7-12 Jun 1987)			
19	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011436	MN -79	12:43323
CONF-870604-	(International symposium on safety aspects of the aging and maintenance of nuclear power plants, Vienna, Austria, 29 Jun-3 Jul 1987)			
1	*See* IAEA-SM-295/35	E 1.99: DE87011673	MN -80	12:43350
2	*See* BNL-NUREG-40049	E 1.99: DE87013299	MN -80	12:43336
CONF-870610-	(5. national synchrotron radiation instrumentation conference, Madison, WI, USA, 21-25 Jun 1987)			
3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011676	MN -37	12:43850
5	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87011679	MN -28	12:43851
7	*See* LBL-23623	E 1.99: DE87012876	MN -28	12:43818
8	*See* BNL-39982	DE87012481	MN -34C	12:43899
CONF-870622-	(19. fluid dynamics, plasma dynamics, and laser conference, Honolulu, HI, USA, 8-10 Jun 1987)			
9	*See* UCRL-95670	E 1.99: DE87012628	MN -34A	12:43760
CONF-870625-	(28. U.S. symposium on rock mechanics, Tucson, AZ, USA, 29 Jun-1 Jul 1987)			
15	*See* LBL-23464	E 1.99: DE87011102	MN -11	12:44222
17	*See* RHO-BW-SA-658	E 1.99: DE87012639	MN -70	12:43091
CONF-870631-	(8. US symposium on compact toroid research and the 9. US/Japan workshop on compact toroids, College Park, MD, USA, 4-5 Jun 1987)			
2	*See* LA-UR-87-1846	E 1.99: DE87011796	MN -20g	12:44732
CONF-870653-	(A critical path in developing low-level radioactive waste disposal facilities, Boston, MA, USA, 29 Jun-1 Jul 1987)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011669	MN -70B	12:43045
CONF-870656-	(6. Institute of Electrical and Electronic Engineers pulsed power conference, Arlington, VA, USA, 29 Jun-1 Jul 1987)			
12	*See* SAND-87-0314C	DE87011723	MN -28	12:43821
15	*See* SAND-87-0107C	E 1.99: DE87011725	MN -28	12:43862
19	*See* SAND-87-0084C	E 1.99: DE87011284	MN -28	12:43861
20	*See* SAND-87-0081C	E 1.99: DE87011283	MN -28	12:43860
23	NTIS, PC A02; 3	DE87011655	MN -38	12:43716
25	*See* LA-UR-87-2094	DE87011763	MN -38	12:43788
26	*See* LA-UR-87-2079	E 1.99: DE87011766	MN -21	12:43787
27	*See* SAND-87-0100C	E 1.99: DE87011856	MN -38	12:43792
28	*See* SAND-87-0303C	E 1.99: DE87011863	MN -21	12:43820
29	*See* SAND-87-0189C	DE87011862	MN -28	12:43863
30	*See* SAND-87-0257C	E 1.99: DE87011632	MN -21	12:44739
31	*See* SAND-87-0460C	DE87011857	MN -21	12:44740
32	NTIS, PC A02; 3	DE87011678	MN -38	12:43786
33	*See* LA-UR-87-2124	DE87011747	MN -38	12:43711
34	*See* LA-UR-87-2192	DE87011734	MN -38	12:43789
35	*See* SAND-87-1367C	DE87012130	MN -37	12:43796
38	*See* SAND-87-0017C	DE87012020	MN -37	12:43791
40	*See* SAND-87-0172C	DE87012014	MN -21	12:44738
41	*See* SAND-87-7031C	E 1.99: DE87012372	MN -28	12:43864
44	*See* SAND-87-0128C	E 1.99: DE87014170	MN -25	12:43736
CONF-870664-	(25. symposium on engineering aspects of magnetohydrodynamics, Bethesda, MD, USA, 24-26 Jun 1987)			
1	NTIS, PC A02; 3	DE87011448	MN -38	12:43434
CONF-870682-	(Workshop on novel mechanisms for superconductivity, Berkeley, CA, USA, 22-25 Jun 1987)			
5	*See* LA-UR-87-2456	E 1.99: DE87013163	MN -25	12:43510
CONF-870691-	(Review of progress in quantitative NDE, Williamsburg, VA, USA, 21-26 Jun 1987)			
1	*See* UCRL-96376	E 1.99: DE87013786	MN -38	12:43784
CONF-8706125-	(Conference on advances in cryogenic engineering, St. Charles, IL, USA, 14-18 Jun 1987)			
4	*See* UCRL-95927	E 1.99: DE87011923	MN -20	12:44743
5	*See* UCRL-96001	E 1.99: DE87011922	MN -20b	12:44744
6	*See* UCRL-96661	E 1.99: DE87011553	MN -20a	12:44745
10	*See* BNL-40064	E 1.99: DE87013307	MN -25	12:43580
11	*See* FNAL-TM-1464	DE87013849	STD -25	12:43724

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CONF-8706143-	(IAU colloquium 95, Tucson, AZ, USA, 1-5 Jun 1987)				
3	*See* LA-UR-87-2314	E 1.99:	DE87013149	MN -34B	12:44253
CONF-8706146-	(NATO advanced workshop on narrow band phenomena, Staverden, Netherlands, 1-5 Jun 1987)				
1	*See* LA-UR-87-1755	E 1.99:	DE87010132	MN -34	12:44615
CONF-8706147-	(Workshop on new developments in particle acceleration techniques, Orsay, France, 29 Jun-4 Jul 1987)				
1	*See* UCRL-95909	E 1.99:	DE87011560	MN -28	12:43827
CONF-8706150-	(International school of space simulation, La Londe les Maures, France, 15-21 Jun 1987)				
1	*See* LA-UR-87-2052	E 1.99:	DE87011769	MN -34	12:44449
CONF-8706152-	(European Materials Research Society conference, Strasbourg, France, 2-5 Jun 1987)				
3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012291	MN -28	12:43619
CONF-8706156-	(Workshop on evaluation of the TRAC dispersion model, Golden, CO, USA, 24 Jun 1987)				
1	*See* RFP-4144	E 1.99:	DE87012084	MN -11	12:43965
CONF-8706157-	(23. AIAA/SAE/ASME/ASEE joint propulsion conference, San Diego, CA, USA, 29 Jun-2 Jul 1987)				
2	*See* UCRL-96832	E 1.99:	DE87012909	MN -21	12:44746
3	*See* N-87-22034				12:43549
4	*See* N-87-22806				12:43707
CONF-8706161-	(2. international conference on muon and pion interactions in matter, Dubna, USSR, 30 Jun-4 Jul 1987)				
1	*See* LA-UR-87-2153		DE87011739	MN -34	12:44426
CONF-8706163-	(Plasma focus and z pinch workshop, Toledo, Spain, 29-30 Jun 1987)				
1	*See* LA-UR-87-2102	E 1.99:	DE87011760	MN -20f	12:44684
CONF-8706171-	(Meeting on the physics and technology of amorphous SiO/sub 2/, Les Arcs, France, 29 Jun-3 Jul 1987)				
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87012255	MN -34	12:43620
CONF-8706176-	(Workshop and symposium on the physics of low energy, stored, and trapped particles, Stockholm, Sweden, 14-18 Jun 1987)				
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011671	MN -34A	12:44416
CONF-8706179-	(JOWOG 39 NDE SUBWOG meeting, Aldermaston, UK, 1 Jun 1987)				
1	*See* SAND-87-1319C	E 1.99:	DE87010038	MN -38	12:43782
CONF-8706182-	(All-Union symposium on physics of nuclear fission, Obninsk, USSR, 2-5 Jun 1987)				
1	*See* UCRL-97081	E 1.99:	DE87013114	MN -34C	12:44568
CONF-870701-	(8. international congress of radiation research, Edinburgh, UK, 19-24 Jul 1987)				
2	*See* DOE/ER/00038-3004	E 1.99:	DE87012205	MN -34A	12:44417
CONF-870705-	(Annual meeting of the Health Physics Society, Salt Lake City, UT, USA, 5-9 Jul 1987)				
1	*See* DP-MS-86-212	E 1.99:	DE87012388	MN -70B	12:43055
CONF-870706-	(Summer computer simulation conference, Montreal, Canada, 27-29 Jul 1987)				
3	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013673	MN -102	12:44775
CONF-870712-	(Numerical methods in laminar and turbulent flow, Montreal, Quebec, Canada, 6-10 Jul 1987)				
4	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87011392	MN -80	12:43771
CONF-870713-	(28. INMM annual meeting on safeguards: a mature technology, Newport Beach, CA, USA, 12-15 Jul 1987)				
18	*See* SAND-87-0944C		DE87011865	MN -32	12:44813
25	*See* SAND-87-1024C		DE87012019	MN -32	12:43795
39	*See* UCRL-96933	E 1.99:	DE87013225	MN -15	12:43117
41	*See* LA-UR-87-2223		DE87013132	MN -15	12:43108
42	*See* LA-UR-87-2241		DE87013133	MN -15	12:43109
43	*See* RFP-3948	E 1.99:	DE87013380	MN -15	12:43111
44	*See* RFP-4146	E 1.99:	DE87013385	MN -15	12:43112
45	*See* UCRL-96905		DE87013473	MN -15	12:43116
47	*See* UCRL-96045	E 1.99:	DE87013224	MN -15	12:43115
48	*See* BNL-40058		DE87013310	MN -37	12:43919
51	*See* LA-UR-87-2254	E 1.99:	DE87013136	MN -37	12:43904
CONF-870715-	(15. international conference on the physics of electronic and atomic collisions, Brighton, UK, 22-28 Jul 1987)				
1	*See* LA-UR-87-2249	E 1.99:	DE87011728	MN -34A	12:44427
2	*See* LA-UR-87-2313	E 1.99:	DE87013148	MN -34A	12:44428
CONF-870719-	(2. international conference on phase transformations in solids, Cambridge, UK, 6-10 Jul 1987)				
3	*See* UCRL-95832		DE87013561	MN -25	12:43561
CONF-870724-	(24. annual conference on nuclear and space radiation in electronics, Snowmass, CO, USA, 28-31 Jul 1987)				
1-FP	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011658	MN -38	12:43717
16	*See* SAND-87-0292C	E 1.99:	DE87012370	MN -34A	12:44789
CONF-870733-	(Pacific workshop and meeting on analytical electron microscopy, Kona, HI, USA, 12-17 Jul 1987)				
9	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013679	MN -25	12:43582

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11	*See* UCRL-96696	E 1.99:	DE87013801	MN -25	12:43566
CONF-870753-	(5. topical conference of the American Physical Society on shockwaves in condensed matter, Monterey, CA, USA, 20-23 Jul 1987)				
15	*See* LA-UR-87-2171	E 1.99:	DE87011736	MN -34	12:43544
16	*See* LA-UR-87-2199		DE87011732	MN -38	12:43729
20	*See* UCRL-96435		DE87012245	MN -34	12:43638
21	*See* UCRL-96930	E 1.99:	DE87012242	MN -34A	12:43677
29	*See* SAND-87-0931C	E 1.99:	DE87012738	MN -37	12:43926
33	*See* UCRL-96524	E 1.99:	DE87012633	MN -34	12:44620
36	*See* UCRL-96498		DE87012631	MN -34	12:44618
44	*See* SAND-87-0662C	E 1.99:	DE87012974	MN -34	12:44790
50	*See* UCRL-96398		DE87013486	MN -38	12:43740
51	*See* UCRL-96361		DE87013484	MN -25	12:43564
58	*See* UCRL-96496		DE87013227	MN -4	12:43565
63	*See* LA-UR-87-2282	E 1.99:	DE87013140	MN -38	12:43730
64	*See* UCRL-96521	E 1.99:	DE87013788	MN -34A	12:44619
65	*See* UCRL-96523		DE87013787	MN -34B	12:44377
CONF-870754-	(11. international AIRAPT conference, Kiev, USSR, 12-17 Jul 1987)				
3	*See* UCRL-97186	E 1.99:	DE87013800	MN -34A	12:44621
CONF-870758-	(International conference on measurement of soil and plant water status, Logan, UT, USA, 6-10 Jul 1987)				
2	*See* LA-UR-87-1526	E 1.99:	DE87010104	MN -11	12:44221
CONF-870767-	(Focus on eastern regional ground water issues, Burlington, VT, USA, 14-16 Jul 1987)				
1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011127	MN -70B	12:43046
CONF-870775-	(International conference on genetic algorithms and their applications, Cambridge, MA, USA, 27-29 Jul 1987)				
1	*See* LA-UR-87-1863		DE87011793	MN -48	12:44185
CONF-870779-	(3. workshop on heavy charged particles in biology and medicine, Darmstadt, F.R. Germany, 13-15 Jul 1987)				
1	*See* BNL-39930	E 1.99:	DE87012114	MN -48	12:44198
CONF-870787-	(International Atomic Energy Agency technical committee meeting on negative ion beam sources, Culham, UK, 15-17 Jul 1987)				
1	*See* UCRL-96913	E 1.99:	DE87012240	MN -34A	12:44433
CONF-870791-	(Annual health physics summer school, Pocatello, ID, USA, 12-17 Jul 1987)				
1	*See* PNL-SA-15051	E 1.99:	DE87013327	MN -11	12:44032
CONF-870796-	(63. biennial carbon conference, Worcester, MA, USA, 19-24 Jul 1987)				
1	*See* UNI-SA-207	E 1.99:	DE87012230	MN -80	12:43639
CONF-870804-	(22. intersociety energy conversion engineering conference, Philadelphia, PA, USA, 10-14 Aug 1987)				
	See N-87-22310				12:43442
21	*See* GA-A-18878		DE87012088	MN -77	12:43262
22	*See* N-87-22001				12:43171
23	*See* N-87-22003				12:43275
24	*See* N-87-22004				12:43236
25	*See* N-87-22174				12:43375
26	*See* N-87-22307				12:43381
27	*See* N-87-22308				12:43382
29	*See* N-87-22311				12:43383
31	*See* N-87-22802				12:43177
32	*See* N-87-23020				12:43172
33	*See* N-87-23028				12:43173
34	*See* N-87-23029				12:43384
35	*See* N-87-23027				12:43276
CONF-870812-	(9. SMIRT: international conference on structural mechanics in reactor technology, Lausanne, Switzerland, 17-21 Aug 1987)				
22	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011460	MN -79b	12:43338
23	NTIS, PC A02/M A01; 1 (GPO Dep.)	E 1.99:	DE87011462	MN -79r	12:43304
24	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011465	MN -79	12:43339
25	NTIS, PC A02; 3		DE87011471	MN -80	12:43288
CONF-870816-	(24. national heat transfer conference and exhibition, Pittsburgh, PA, USA, 9-12 Aug 1987)				
24	NTIS, PC A02/M A01; 1 (GPO Dep.)	E 1.99:	DE87011459	MN -79	12:43270
25	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011463	MN -78	12:43340
CONF-870818-	(International post-SMIRT seminar on accident sequence modelling: human actions, system response, intelligent decision aids, Munich, F.R. Germany, 24-25 Aug 1987)				
1	*See* UCRL-96931	E 1.99:	DE87012629	MN -80	12:43313
CONF-870820-	(PSA 87: international topical meeting on probabilistic safety assessment and risk management, Zurich, Switzerland, 31 Aug-4 Sep 1987)				
2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87011648	MN -78	12:43341
3	*See* UNI-SA-208	E 1.99:	DE87012231	MN -80	12:43333
4	*See* BNL-NUREG-39974	E 1.99:	DE87012493	MN -78	12:43335

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CONF-870822-	(American Institute of Chemical Engineers summer national meeting, Minneapolis, MN, USA, 16-19 Aug 1987)			
5	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013680	MN -80	12:43310
6	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013678	MN -34C	12:43702
CONF-870830-	(AIAA aerodynamics flight mechanics conference, Monterey, CA, USA, 17-19 Aug 1987)			
4-Draft	*See* SAND-86-2944C	E 1.99: DE87004522	MN -96A	12:43469
CONF-870831-	(International conference on parallel processing, St. Charles, IL, USA, 17-21 Aug 1987)			
3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012953	MN -32	12:44776
4	*See* N-87-23201			12:44786
CONF-870839-	(3. international symposium on environmental degradation of materials in nuclear power systems: water reactors, Traverse City, MI, USA, 30 Aug-3 Sep 1987)			
2	*See* UNI-SA-190	E 1.99: DE87012225	MN -80	12:43332
CONF-870843-	(International conference on electronic structure in phase stability in advanced ceramics, Argonne, IL, USA, 17-19 Aug 1987)			
1	*See* SAND-87-1031C	E 1.99: DE87012407	MN -34	12:44617
CONF-870847-	(14. international congress and general assembly of the International Union of Crystallography, Perth, Australia, 12-20 Aug 1987)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013540	MN -34	12:43520
CONF-870855-	(20. international cosmic ray conference, Moscow, USSR, 2-15 Aug 1987)			
2	*See* ANL-HEP-CP-87-38	E 1.99: DE87011473	MN -37	12:43897
4	*See* ANL-HEP-CP-87-39	E 1.99: DE87011381	MN -37	12:43898
CONF-870859-	(9. annual low-level radioactive waste management program conference, Denver, CO, USA, 25-27 Aug 1987)			
3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012938	MN -70A	12:43047
4	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87013187	MN -41	12:43048
CONF-870863-	(Seminar on small and medium-sized nuclear reactors: safety and licensing issues, Lausanne, Switzerland, 24-26 Aug 1987)			
2	*See* GA-A-18857	E 1.99: DE87013451	MN -77	12:43261
CONF-870864-	(4. American Meteorological Society's conference on mountain meteorology, Seattle, WA, USA, 25-28 Aug 1987)			
8	*See* UCRL-96092	E 1.99: DE87010870	MN -11	12:43967
CONF-870873-	(18. conference on low temperature physics, Kyoto, Japan, 20-26 Aug 1987)			
8	*See* LBL-23531	E 1.99: DE87011101	MN -34	12:43547
10	*See* DOE/ER/45297-1	DE87012724	MN -25	12:43531
CONF-870891-	(Symposium on advanced accelerator concepts, Madison, WI, USA, 21-27 Aug 1987)			
1	*See* SLAC-PUB-4161	E 1.99: DE87010540	MN -28	12:43836
CONF-870893-	(6. international conference on rapidly quenched metals, Montreal, Canada, 3-7 Aug 1987)			
3	*See* LA-UR-87-2571	E 1.99: DE87013175	MN -25	12:43545
CONF-870894-	(American Society of Civil Engineers engineering hydrology symposium, Williamsburg, VA, USA, 3-7 Aug 1987)			
1	*See* LBL-23371	DE87011226	MN -70	12:43082
CONF-870899-	(4. symposium on logic programming, San Francisco, CA, USA, 31 Aug-4 Sep 1987)			
2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011399	MN -32	12:44804
CONF-8708100-	(International conference on luminescence, Beijing, China, 17-21 Aug 1987)			
1	*See* LA-UR-87-2121	E 1.99: DE87011748	MN -34	12:43628
CONF-8708101-	(6. international symposium on capture gamma-ray spectroscopy, Leuven, Belgium, 31 Aug-4 Sep 1987)			
3	*See* UCRL-95967	E 1.99: DE87013488	MN -34C	12:44376
CONF-8708106-	(13. annual underground coal gasification symposium, Laramie, WY, USA, 24-26 Aug 1987)			
2	*See* UCRL-96461	DE87013115	MN -109	12:42922
3	*See* UCRL-96464	E 1.99: DE87013794	MN -109	12:42923
4	*See* UCRL-97203	E 1.99: DE87013793	MN -109	12:42924
CONF-8708108-	(Conference on voice recognition applications in manufacturing, Schaumburg, IL, USA, 25-26 Aug 1987)			
1	*See* BDX-613-3805	E 1.99: DE87012988	MN -38	12:43785
CONF-8708115-	(39. technology transfer conference, Nashville, TN, USA, 6-7 Aug 1987)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012934	MN -25	12:43507
CONF-8708116-	(6. international conference on dynamical processes in excited states of solids, Tsukuba, Japan, 11-14 Aug 1987)			
1	*See* UCRL-96184	E 1.99: DE87013497	MN -25	12:43676
CONF-870905-	(6. Pacific Basin nuclear conference, Beijing, China, 6-11 Sep 1987)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87007011	MN -86	12:43032

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CONF-870937-	(6. international conference on heavy metals in the environment, New Orleans, LA, USA, 15-18 Sep 1987)				
4	*See* BNL-39995	E 1.99:	DE87013304	MN -102	12:42914
CONF-870947-	(12. conference on the numerical simulation of plasmas, San Francisco, CA, USA, 20-23 Sep 1987)				
3	*See* SAND-87-1745C	E 1.99:	DE87012403	MN -32	12:44791
CONF-870959-	(International conference on neutron physics, Kiev, USSR, 21 Sep 1987)				
1	*See* UCRL-97182	E 1.99:	DE87013791	MN -34C	12:44604
CONF-870981-	(Influence of new materials development on weldability, Columbus, OH, USA, 29 Sep-1 Oct 1987)				
1	NTIS, PC A02; 3		DE87014055	MN -25	12:43583
CONF-870996-	(13. international conference on very large data bases, Brighton, UK, 1-4 Sep 1987)				
1	*See* LBL-22393	E 1.99:	DE87010986	MN -32	12:44811
CONF-8709104-	(ANS topical conference on population exposure from nuclear fuel cycle, Oak Ridge, TN, USA, 15-18 Sep 1987)				
1	*See* Y/TS-220/R1	E 1.99:	DE87012331	MN -70B	12:43099
CONF-8709108-	(Digital signal processing conference, Florence, Italy, 7-10 Sep 1987)				
1	*See* UCRL-96531		DE87011327	MN -32	12:44800
CONF-8709114-	(International Society for Hybrid Microcircuits conference, Minneapolis, MN, USA, 28-30 Sep 1987)				
1	*See* BDX-613-3721	E 1.99:	DE87012987	MN -38	12:43715
CONF-8709116-	(6. international conference on solid state ionics, Garmisch-Partenkirchen, F.R. Germany, 6-11 Sep 1987)				
2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013543	MN -25	12:43689
CONF-871027-	(172. meeting of the Electrochemical Society, Honolulu, HI, USA, 18-23 Oct 1987)				
3	*See* LA-UR-87-1035	E 1.99:	DE87007509	MN -25	12:43543
5	*See* SAND-87-0619C	E 1.99:	DE87008514	MN -34	12:44411
12	*See* SAND-87-1156C		DE87009297	MN -25	12:43559
17	*See* SAND-87-0953C	E 1.99:	DE87009715	MN -94cc	12:43794
19	*See* BDX-613-3695	E 1.99:	DE87008831	MN -25	12:43516
20	*See* SAND-87-7127C	E 1.99:	DE87010737	MN -94cb	12:43385
22	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87011360	MN -25	12:43521
25	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011356	MN -94cc	12:43379
26	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011364	MN -110	12:43380
27	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011365	MN -94cc	12:43522
31	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87011359	MN -4	12:43523
CONF-871028-	(Instrument Society of America international conference and exhibit, Anaheim, CA, USA, 5-8 Oct 1987)				
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87010014	MN -80	12:43342
CONF-871030-	(Coal science international conference, Maastricht, Netherlands, 26-30 Oct 1987)				
6	*See* ECN-87-071			ND -113	12:42950
7	*See* ECN-87-077			ND -113	12:42951
CONF-871040-	(International symposium on pyrotechnics and explosives, Beijing, China, 12-15 Oct 1987)				
3	*See* LA-UR-87-928	E 1.99:	DE87007453	MN -45	12:43941
4	*See* UCRL-95459	E 1.99:	DE87008421	MN -35	12:43944
5	*See* UCRL-95461	E 1.99:	DE87008423	MN -35	12:43945
6	*See* UCRL-95818	E 1.99:	DE87009137	MN -45	12:43948
7	*See* UCRL-95483	E 1.99:	DE87009581	MN -35	12:43947
8	*See* UCRL-95443	E 1.99:	DE87010340	MN -45	12:43943
9	*See* SAND-86-2339C	E 1.99:	DE87011282	MN -45	12:43942
10	*See* UCRL-95462	E 1.99:	DE87012177	MN -45	12:43946
CONF-871086-	(Institute of Electrical and Electronic Engineers Professional Communication Society conference, Winnipeg, Canada, 14-16 Oct 1987)				
1	*See* UCRL-96697	E 1.99:	DE87010808	MN -13	12:44763
CONF-871089-	(American Society for Information Science's annual meeting, Boston, MA, USA, 4-8 Oct 1987)				
2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012535	MN -13	12:43402
CONF-871099-	(International conference on materials technology, Santiago, Chile, 4-9 Oct 1987)				
1	*See* UCRL-95988	E 1.99:	DE87011884	MN -25	12:43562
2	*See* UCRL-96344		DE87011559	MN -25	12:43563
CONF-8710100-	(NATO/AGARD symposium on effects of electromagnetic noise and interference on the performance of military radio communications systems, Lisbon, Portugal, 26-30 Oct 1987)				
1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011584	MN -97a	12:44387
CONF-8710102-	(3. mine ventilation symposium, University Park, PA, USA, 12-14 Oct 1987)				
1	*See* LA-UR-87-1981		DE87011778	MN -38	12:43774
2	*See* LA-UR-87-1980		DE87011779	MN -38	12:43728
CONF-8710103-	(Project Management Institute seminar/symposium, Milwaukee, WI, USA, 2-7 Oct 1987)				
1	*See* SAND-86-2952C	E 1.99:	DE87011716	MN -13	12:44765

Report Number	Availability Source	File Number	Distribution Category	Abstract Number
CONF-8710106-	(3. annual expert systems in government conference, Washington, DC, USA, 19-23 Oct 1987)			
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87012258	MN -13	12:44752
CONF-8710124-	(Conference on systems, man, and cybernetics, Alexanderia, VA, USA, 20-23 Oct 1987)			
1	*See* LA-UR-87-2603	DE87013178	MN -13	12:44757
COO-				
3130TB-263	*See* DOE/ER/03130-263	E 1.99: DE87011622	MN -37	12:43901
3496-82	*See* DOE/ER/03496-82	E 1.99: DE87013693	MN -34C	12:44502
3539-43	*See* DOE/ER/03539-43	E 1.99: DE87013921	MN -34C	12:44458
4831-10	*See* DOE/ER/04831-10	E 1.99: DE87010384	MN -34C	12:44541
CRC-PUB-				
125	*See* PB-87-205175/XAB			12:44129
CRDEC-TR-				
87011	*See* AD-A-180963/1/XAB			12:43668
CREGU-				
1	NTIS (US Sales Only), PC A17/MF A01	DE87752247	MN -51	12:43013
3	NTIS (US Sales Only), PC A12/MF A01	DE87752279	MN -51	12:43030
CRN-HE-				
85-03	NTIS (US Sales Only), PC A03/MF A01	DE87752229	MN -34D	12:44485
CRN-PN-				
86-08	NTIS (US Sales Only), PC A03/MF A01	DE87752203	MN -34C	12:44536
86-10	NTIS (US Sales Only), PC A07/MF A01	DE87752202	MN -34C	12:44522
CRREL-SR-				
87-6	*See* AD-A-180959/9/XAB			12:43445
CSTB-R-				
36-85-L	NTIS (US Sales Only), PC A02; 3	DE87753174	MN -59A	12:43182
CTH-IEFT/PP-				
1986-02	NTIS (US Sales Only), PC A03/MF A01	DE87752424	MN -20	12:44641
1986-04	NTIS (US Sales Only), PC A03/MF A01	DE87752425	MN -20	12:44642
1986-11	NTIS (US Sales Only), PC A02/MF A01	DE87752428	MN -20	12:44643
1986-12	NTIS (US Sales Only), PC A02/MF A01	DE87752429	MN -20	12:44644
1986-13	NTIS (US Sales Only), PC A02/MF A01	DE87752430	MN -20	12:44645
1986-14	NTIS (US Sales Only), PC A03/MF A01	DE87752431	MN -20	12:44646
CTR-				
3-9-84-364-2	*See* PB-87-202859/XAB			12:42964
3-9-84-364-4F	*See* PB-87-201471/XAB			12:42947
CVD-TR-				
9076	*See* AD-A-181095/1/XAB			12:43714
DA-TR-				
8705	*See* NUREG/CR-4953	TI87900898	MN -78	12:43366
DASA-				
544(EX)	*See* AD-A-995485/0/XAB			12:43955
DME-				
07	NTIS, PC A05/MF A01			12:43621
DOE/AL/33183-				
T3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011046	MN -96	12:43496
DOE/AL/33218-				
T9	NTIS MF A01; 2 (GPO Dep.)	E 1.99: DE87009832	MN -71	12:43050
DOE/BP-				
757	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87011209	MN -11	12:44140
DOE/BP/11287-				
6	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE87011896	MN -95d	12:43447
T1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87013805	MN -95d	12:43448
DOE/BP/11888-				
3	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87013982	MN -11	12:44204
DOE/BP/12659-				
3	NTIS, PC A09/MF A01; 1 (GPO Dep.)	E 1.99: DE87013981	MN -11	12:43138
DOE/BP/13655-				
1	NTIS, PC A10; 3	DE87011895	MN -11	12:43973
DOE/BP/17608-				
T1	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE87013424	MN -61A	12:43146
DOE/BP/35474-				
T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87013426	MN -61A	12:43147
DOE/BP/39643-				
2	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87013417	MN -11	12:44141
DOE/CE-				
0193	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013989	MN -95	12:43495
DOE/CE/15254-				
T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87010799	MN -95f	12:43007
T2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010798	MN -95f	12:43008
DOE/CE/26566-				
T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012669	MN -95d	12:43479
DOE/CE/40746-				
T1-Add.	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013465	MN -95f	12:43474
DOE/CE/63482-				
T3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013404	MN -95d	12:43449
DOE/CE/64856-				
T1	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99: DE87013913	MN -95	12:43450
DOE/CH/00085-				
T1	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE87013667	MN -48	12:44036
DOE/CH/10262-				
T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87008526	MN -70	12:43051

Report Number	Availability Source	File Number		Distribution Category	Abstract Number
DOE/CH/10288-					
5	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013728	MN -48	12:44192
DOE/EIA-					
0095(86)	NTIS, PC A13/MF A01 - GPO; 1 (GPO Dep.)	E 1.99:	DE87014029	MN -98E	12:43425
0130(87/ 05)	NTIS, PC A08/MF A01 - GPO; 1 (GPO Dep.)	E 1.99:	DE87013860	MN -98C	12:43004
0130(87/ 06)	NTIS, PC A07/MF A01 - GPO; 1 (GPO Dep.)	E 1.99:	DE87014134	MN -98C	12:43005
0202(87/ 3Q)	NTIS, PC A04/MF A01 - GPO; 1 (GPO Dep.)	E 1.99:	DE87013432	MN -98	12:43420
0226(87/ 05)	NTIS, PC A03/MF A01 - GPO; 1 (GPO Dep.)	E 1.99:	DE87014003	MN -98E	12:43426
0469(86)	NTIS, PC A04 - GPO; 3		DE87012674	MN -98	12:43430
DOE/ER-					
0156/ 4	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013771	MN -41	12:44037
0320	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012324	MN -11	12:44216
0321	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012368	MN -11	12:44102
0322	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011110	MN -05	12:43413
0330	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012528	MN -13	12:44753
0334	NTIS, PC A10/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012950	MN -20	12:44713
DOE/ER/00038-					
3004	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012205	MN -34A	12:44417
DOE/ER/01560-					
21	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013899	MN -80	12:43324
DOE/ER/02171-					
227	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014043	MN -34C	12:44560
228	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013710	MN -34C	12:44501
DOE/ER/02944-					
12	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87013994	MN -4	12:43704
DOE/ER/03065-					
52	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013950	MN -34D	12:44457
DOE/ER/03130-					
263	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011622	MN -37	12:43901
DOE/ER/03346-					
278	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014046	MN -34C	12:44550
DOE/ER/03496-					
82	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013693	MN -34C	12:44502
DOE/ER/03539-					
43	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013921	MN -34C	12:44458
DOE/ER/04043-					
47	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013949	MN -34C	12:44503
DOE/ER/04831-					
10	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010384	MN -34C	12:44541
DOE/ER/10346-					
6	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013704	MN -4	12:43670
DOE/ER/10588-					
T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013709	MN -25	12:43584
DOE/ER/13013-					
4	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012092	MN -11	12:44217
DOE/ER/13044-					
9	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012412	MN -34	12:44444
DOE/ER/13171-					
T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013030	MN -34A	12:44418
DOE/ER/13335-					
2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013941	MN -25	12:43508
DOE/ER/13352-					
3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013295	MN -48	12:44180
DOE/ER/13383-					
2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014047	MN -4	12:43671
DOE/ER/13585-					
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012197	MN -28	12:43817
DOE/ER/13597-					
1	NTIS, PC A11/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013907	MN -38	12:43772
DOE/ER/13624-					
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013944	MN -4	12:43128
DOE/ER/25010-					
2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87012519	MN -32	12:44777
T2	NTIS, PC A02; 3		DE87012954	MN -32	12:44778
T3	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012955	MN -32	12:44779
DOE/ER/40091-					
T4	NTIS MF A01; 2 (GPO Dep.)	E 1.99:	DE87012034	MN -20f	12:44647
DOE/ER/40150-					
30	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87012465	MN -34A	12:44419
33	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87012467	MN -34C	12:44561
34	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012463	MN -28	12:43832
DOE/ER/40251-					
2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87013943	MN -34C	12:44504
DOE/ER/40310-					
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013898	MN -34C	12:43902
DOE/ER/40314-					
1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013455	MN -34C	12:44527
DOE/ER/45025-					
15	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87012743	MN -34	12:43524
18	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE87012741	MN -34	12:43525
DOE/ER/45049-					
1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013687	MN -25	12:43585
DOE/ER/45093-					
T2	NTIS, PC A06; 3		DE87013767	MN -25	12:43586

Report Number	Availability Source	File Number	Distribution Category	Abstract Number
DOE/ER/45094-4	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013513	MN -25	12:43526
DOE/ER/45098-23	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013922	MN -25	12:43654
DOE/ER/45133-3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87014090	MN -25	12:43509
DOE/ER/45163-8	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011827	MN -34A	12:43527
9	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011828	MN -34	12:43528
DOE/ER/45168-3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013858	MN -25	12:43587
DOE/ER/45274-1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013904	MN -25	12:43529
DOE/ER/45282-5	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012460	MN -34A	12:44611
DOE/ER/45283-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013856	MN -25	12:43622
DOE/ER/45285-1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87014123	MN -25	12:43530
DOE/ER/45297-1	NTIS, PC A02; 3	DE87012724	MN -25	12:43531
2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012725	MN -25	12:43532
DOE/ER/45310-2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87012746	MN -34	12:44612
DOE/ER/52127-20	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE87012721	MN -20	12:44648
DOE/ER/53194-T3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012459	MN -20f	12:44445
DOE/ER/60393-2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013456	MN -48	12:44200
DOE/ER/60394-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013698	MN -48	12:44181
DOE/ER/60397-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013127	MN -11	12:43960
T2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013995	MN -11	12:43974
DOE/ER/60452-1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013517	MN -41	12:44201
DOE/ER/70294-T2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013708	MN -25	12:43533
DOE/ET/10815-120	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87012966	MN -112	12:43435
DOE/ET/14692-T19	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010971	MN -101	12:43421
DOE/ET/20181-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013706	MN -11	12:43961
DOE/ET/26829-1	NTIS, PC A02; 3	DE87013076	MN -94cc	12:43690
DOE/ET/27014-T20	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87013389	MN -66a	12:43191
DOE/ET/33006-006	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE87013769	MN -22	12:43118
DOE/ET/51013-223	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011038	MN -20	12:44714
DOE/ET/53088-270	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87012234	MN -20g	12:44446
273	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012233	MN -28	12:43833
281	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012663	MN -20	12:44635
284	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87013006	MN -20f	12:44649
285	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013007	MN -20f	12:44650
DOE/EV/10402-T5	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012339	MN -37	12:44186
DOE/EV/13573-5	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013692	MN -11	12:44024
DOE/FE/60177-2396	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87014012	STD -123	12:43010
2410	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87014160	STD -123	12:43011
DOE/ID-12109	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013846	STD -11	12:44055
DOE/ID/01745-T14	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE87014007	MN -112	12:43436
DOE/ID/12526-T2	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99: DE87013077	MN -66b	12:43190
T4	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013081	MN -66b	12:44218
T5	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87013079	MN -66b	12:44219
DOE/ID/12584-1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87010853	STD -70A	12:44047
7	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87013847	STD -70A	12:43104
9	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013579	STD -70A	12:43052
DOE/ID/12647-T1	NTIS, PC A24/MF A01; 1 (GPO Dep.)	E 1.99: DE87012422	MN -78	12:43718
DOE/ID/12651-T1-Vol.1	NTIS, PC A16/MF A01; 1 (GPO Dep.)	E 1.99: DE87012418	MN -78	12:43719
T1-Vol.2	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99: DE87012419	MN -78	12:43720
T1-Vol.3	NTIS, PC A18; 3	DE87012420	MN -78	12:43721

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DOE/LC/11049-				
2352	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87006487	STD -107	12:43975
DOE/MA-				
0282	NTIS, PC A20/MF A01; 1 (GPO Dep.)	E 1.99: DE87013099	MN -13	12:44764
0287-2	NTIS, PC A24/MF A01; 1 (GPO Dep.)	E 1.99: DE87013837	MN -13	12:44754
0288-1	NTIS, PC A21/MF A01; 1 (GPO Dep.)	E 1.99: DE87012001	MN -13	12:44755
0288-2	NTIS, PC A20/MF A01; 1 (GPO Dep.)	E 1.99: DE87013836	MN -13	12:44756
0305	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87012898	MN -05	12:43419
DOE/MC/21108-				
2238	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87003823	MN -107	12:42960
DOE/MC/22046-				
2371	NTIS (US Sales Only), PC A07/MF A01; 1 (GPO Dep.)	E 1.99: DE87011136	STD -110	12:43441
DOE/METC-				
87/ 6081	NTIS, PC A99/MF A01; 1 (GPO Dep.)	E 1.99: DE87012948	MN -101	12:42913
DOE/MI/10069-				
T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013910	MN -13	12:44179
DOE/NASA/16310-				
4	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013853	STD -25	12:43534
DOE/NASA/20320-				
72	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87013854	STD -60	12:43197
DOE/NBM-				
7013421	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013421	MN -70	12:43703
7013595	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87013595	MN -63	12:43148
7014065	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE87014065	MN -126	12:42981
DOE/NE/37949-				
T2	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87013556	MN -38	12:43722
DOE/NE/37959-				
6	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87013657	MN -80	12:43289
DOE/NE/44139-				
35	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87014109	STD -70	12:43053
DOE/NV/10384-				
16	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87012986	MN -70	12:44220
DOE/NV/10471-				
T1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87010781	MN -11	12:44048
DOE/OR/00033-				
T325	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87013668	MN -2	12:44505
T326	Massachusetts Institute of Technology, 77 Massachusetts Ave., Cambridge, MA 02139	TI87013903	ND -85	12:43040
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145	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87009533	MN -70A	12:44025
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3	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87013751	MN -108	12:42916
DOE/PC/90533-				
3	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87013748	MN -108	12:43129
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3	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87013282	MN -108	12:42917
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0057-H5	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99: DE87013098	MN -97	12:43427
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86-212	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012388	MN -70B	12:43055
86-213	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013044	MN -70	12:43056
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84-17-1-Rev.4	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87013048	MN -70	12:43057
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85-688	NTIS, PC A11/MF A01; 1 (GPO Dep.)	E 1.99: DE87013042	MN -70	12:43058
85-691	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE87013035	MN -11	12:44057
85-697	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87013038	MN -11	12:44039
85-702	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99: DE87013039	MN -11	12:44058
85-705	NTIS, PC A10/MF A01; 1 (GPO Dep.)	E 1.99: DE87013047	MN -11	12:44040
85-706	NTIS, PC A12/MF A01; 1 (GPO Dep.)	E 1.99: DE87013041	MN -70	12:43059
85-904	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87013051	MN -11	12:43060
86-291	NTIS, PC A10/MF A01; 1 (GPO Dep.)	E 1.99: DE87013052	MN -11	12:44049
86-725	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE87013045	MN -11	12:44059

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91	*See* PB-87-200077/XAB			12:42996
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3107	*See* N-87-22860			12:43555
3136	*See* N-87-22199			12:43732
3369	*See* N-87-22959			12:43807
3379	*See* N-87-23304			12:43632
3531	*See* N-87-22003			12:43275
3533	*See* N-87-22811			12:43554
3546	*See* N-87-22098			12:43158
3549	*See* N-87-23020			12:43172
3551	*See* N-87-22048			12:43675
3556	*See* N-87-22034			12:43549
3562	*See* N-87-22307			12:43381
3564	*See* N-87-21999			12:43186
3566	*See* N-87-22308			12:43382
3569	*See* N-87-22174			12:43375
3576	*See* N-87-23027			12:43276
3577	*See* N-87-22001			12:43171
3591	*See* N-87-23028			12:43173
3600	*See* N-87-23029			12:43384
3601	*See* N-87-22802			12:43177
3607	*See* N-87-22310			12:43442
3608	*See* N-87-22311			12:43383
3626	*See* N-87-22004			12:43236
3639	*See* N-87-22806			12:43707
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87-020	ECN, P.O. Box 1, 1755 ZG Petten, Netherlands		ND -98	12:43403
87-037	ECN, P.O. Box 1, 1755 ZG Petten, Netherlands		ND -103	12:42974
87-053	ECN, P.O. Box 1, 1755 ZG Petten, Netherlands		ND -60	12:43198
87-068	ECN, P.O. Box 1, 1755 ZG Petten, Netherlands		ND -11	12:43977
87-071	ECN, P.O. Box 1, 1755 ZG Petten, Netherlands		ND -113	12:42950
87-074	ECN, P.O. Box 1, 1755 ZG Petten, Netherlands		ND -60	12:43194
87-076	ECN, P.O. Box 1, 1755 ZG Petten, Netherlands		ND -103	12:42975
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87-089	ECN, P.O. Box 1, 1755 ZG Petten, Netherlands		ND -105	12:42967
87-093	ECN, P.O. Box 1, 1755 ZG Petten, Netherlands		ND -107	12:42968
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87-1	NTIS (US Sales Only), PC A10/MF A01; 1	DE87752775	MN -60	12:43193
ECS-SR-				
25	*See* DPST-86-796	E 1.99: DE87013050	MN -11	12:44142
EGG-				
2469-Vol.1	*See* NUREG/CR-4731-Vol.1	TI87013352	MN -78	12:43247
2473-Vol.1	*See* NUREG/CR-4747-Vol.1	TI87013863	MN -78	12:43362
2509	*See* NUREG/CR-4945	TI87013332	MN -78	12:43365
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476	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013830	MN -11	12:44388
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450/ 3-85/ 022A	*See* PB-87-195624/XAB			12:44035
450/ 3-85/ 028A	*See* PB-87-192787/XAB			12:44034
450/ 3-87/ 011	*See* PB-87-194411/XAB			12:43987
503/ SW-87/ 021D	*See* PB-87-206108/XAB			12:43489
530/ SW-87/ 021E	*See* PB-87-206116/XAB			12:43490
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600/ J-86/ 356	*See* PB-87-195426/XAB			12:43994
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600/ J-87-034	*See* PB-87-198370/XAB			12:44122
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87/ 02	*See* PB-87-201364/XAB			12:43497
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EPA/AA/SDSB-				
86/ 3	*See* PB-87-194684/XAB			12:43988
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168	*See* PB-87-194643/XAB			12:44100
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4713	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920538	ND -97e	12:43139
5341	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920544	ND -97e	12:43204
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4439-Vol.1	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920539	ND -105	12:43210
5269	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920461	ND -107	12:43480

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5275	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920540	ND -114	12:43205
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5292	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920549	ND -102	12:42972
EPRI-EA-				
5197	NTIS, PC A07/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303; 1	DE87011022	MN -11	12:43655
5322-SR	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920541	ND -11	12:44041
5335	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920542	ND -11	12:43979
EPRI-EL-				
5331	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920550	ND -97a	12:43233
5332	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920545	ND -97a	12:43234
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5314	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920536	ND -97c	12:43428
EPRI-NP-				
5099	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920525	ND -70B	12:43061
5159M	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920495	ND -80	12:43206
5234	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920513	ND -78	12:43249
5236	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920537	ND -80	12:43311
5238	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920507	ND -78	12:43345
5249-Vol.3	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920502	ND -78	12:43250
5263	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920497	ND -80	12:43290
5265	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920512	ND -78	12:43251
5278	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920546	ND -78	12:43346
5287-CCM	NTIS, PC A07/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303; 1 (GPO Dep.)	E 1.99: DE87013125	MN -78	12:43347
5329	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920531	ND -78	12:43252
5330	NTIS, PC A06/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303; 1 (GPO Dep.)	E 1.99: DE87014089	MN -80	12:43278
5344	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920543	ND -78	12:43348
5345	NTIS, PC A03/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303; 1 (GPO Dep.)	E 1.99: DE87013770	MN -80	12:43535
5364M	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920553	ND -78	12:43241
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41	NTIS (US Sales Only), PC A08/MF A01; 1	DE87752776	MN -98	12:43404
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86-23-Rev	NTIS (US Sales Only), PC A03/MF A01	DE87702561	MN -2	12:43349
87-04	Energie Studie Centrum ECN, P.O. Box 1, 1755 ZG Petten, Netherlands		ND -95	12:43418
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9825	NTIS (US Sales Only), PC A05/MF A01; 1	DE87753145	MN -63	12:43169
9929	NTIS (US Sales Only), PC A06/MF A01; 1	DE87753135	MN -63	12:43151
9973	NTIS (US Sales Only), PC A04; 3	DE87753166	MN -61C	12:43152
9975	NTIS (US Sales Only), PC A07/MF A01; 1	DE87753172	MN -61C	12:43153
9996	NTIS (US Sales Only), PC A06; 3	DE87753168	MN -95d	12:43451
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10036	Commission of the European Communitties, Luxembourg		ND -11	12:44028
10219	NTIS (US Sales Only), PC A04/MF A01; 1	DE87753134	MN -63	12:43170
10323	NTIS (US Sales Only), PC A03; 3	DE87753167	MN -61D	12:43156
10332	NTIS (US Sales Only), PC A05/MF A01; 1	DE87753140	MN -59B	12:43179
10446	NTIS (US Sales Only), PC A08/MF A01	DE87752211	MN -70	12:43062
10489	NTIS (US Sales Only), PC A12/MF A01	DE87752212	MN -70	12:43063
10490	NTIS (US Sales Only), PC A07/MF A01	DE87752213	MN -70	12:43064
10502	NTIS (US Sales Only), PC A06/MF A01	DE87752214	MN -70	12:43065
10509	NTIS (US Sales Only), PC A07/MF A01	DE87752215	MN -70	12:43066
10571-EN	Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities		ND -45	12:42991
10585	NTIS (US Sales Only), PC A02/MF A01	DE87752216	MN -70	12:43067
10593	NTIS (US Sales Only), PC A05/MF A01	DE87752209	MN -25	12:43536
10615	NTIS (US Sales Only), PC A06/MF A01	DE87752208	MN -20a	12:44651
10616	NTIS (US Sales Only), PC A16/MF A01	DE87752207	MN -20a	12:44652
10735	NTIS (US Sales Only), PC A07/MF A01	DE87752210	MN -20d	12:44715

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10774-EN	Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities		ND -37	12:43922
10974-EN	Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities		ND -131	12:43009
EUR-CEA-FC-				
1271	NTIS (US Sales Only), PC A06/MF A01	DE87752359	MN -20g	12:44653
1308	NTIS (US Sales Only), PC A02/MF A01	DE87752360	MN -20a	12:44654
1312	NTIS (US Sales Only), PC A10/MF A01	DE87752361	MN -20f	12:44655
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8	*See* EUR-10615	DE87752208	MN -20a	12:44651
EUR-JET-PR-				
3	*See* EUR-10616	DE87752207	MN -20a	12:44652
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87/ 109-E	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013566	MN -34C	12:44459
FNAL/Pub-				
87/ 106-A	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013482	MN -34B	12:44249
87/ 110-A	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013478	MN -34B	12:44250
87/ 116-A	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013481	MN -34B	12:44251
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1377	NTIS, PC A02/MF A01; 1	DE87013848	STD -38	12:43723
1464	NTIS, PC A02/MF A01; 1	DE87013849	STD -25	12:43724
1465	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013850	STD -25	12:44630
FRA-TM-				
159	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE87012660	MN -79	12:43271
FRNC-TH-				
2077	NTIS (US Sales Only), PC A08/MF A01; 1	DE87753164	MN -38	12:43000
2133	NTIS (US Sales Only), PC A07/MF A01	DE87753162	MN -125	12:42990
2169	NTIS (US Sales Only), PC A05/MF A01	DE87753161	MN -63	12:43157
2360	NTIS (US Sales Only), PC A06/MF A01	DE87753157	MN -94a	12:43374
2407	NTIS (US Sales Only), PC A10/MF A01	DE87753160	MN -59A	12:43183
2428	NTIS (US Sales Only), PC A07/MF A01	DE87753130	MN -61C	12:43130
2664	NTIS (US Sales Only), PC A16/MF A01	DE87753159	MN -63	12:43184
FRT-				
79-7-0216	NTIS (US Sales Only), PC A04/MF A01	DE87753155	MN -95e	12:43136
81-J-0034	NTIS (US Sales Only), PC A03/MF A01	DE87753151	MN -38	12:43725
82-5-1085	NTIS (US Sales Only), PC A04/MF A01	DE87753149	MN -38	12:43726
FSRP-SE-				
265	*See* PB-87-206314/XAB			12:43433
GA-A-				
18853	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012298	MN -20	12:44716
18855	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012023	MN -20a	12:44656
18857	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013451	MN -77	12:43261
18878	NTIS, PC A02; 3	DE87012088	MN -77	12:43262
18883	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013009	MN -20f	12:44657
18916	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87013330	MN -80	12:43325
GANIL-				
1972-1982	NTIS (US Sales Only), PC A10/MF A01	DE87752343	MN -28	12:43815
GANIL-P-				
86-19	NTIS (US Sales Only), PC A04/MF A01	DE87752353	MN -34C	12:44528
86-21	NTIS (US Sales Only), PC A02/MF A01	DE87752354	MN -37	12:43903
86-22	NTIS (US Sales Only), PC A02/MF A01	DE87752355	MN -34C	12:44529
86-25	NTIS (US Sales Only), PC A02/MF A01	DE87752356	MN -34C	12:44530
86-26	NTIS (US Sales Only), PC A02/MF A01	DE87752357	MN -34C	12:44537
86-28	NTIS (US Sales Only), PC A03/MF A01	DE87752358	MN -34C	12:44562
GAO/RCED-				
87-72	US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877	TI87900943	MN -13	12:43107
GEPP-TIS-				
963A	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87013852	MN -97	12:43235
GSF-				
20/ 86	NTIS (US Sales Only), PC A13/MF A01	DE87780171	MN -70	12:43077
GSF-T-				
246	*See* GSF-20/86	DE87780171	MN -70	12:43077
HEDL-				
7507	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85003150	MN -80	12:43315
HEDL-SA-				
3677	NTIS, PC A02/MF A01; 1	DE87009971	MN -79h	12:43623
HEHF-				
54-86	NTIS (US Sales Only), PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87012815	MN -48	12:44202
HEL-TM-				
3-87	*See* AD-A-180776/7/XAB			12:44213
HIFI-				
129	NTIS (US Sales Only), PC A02/MF A01	DE87753009	MN -20f	12:44658
130	NTIS (US Sales Only), PC A03/MF A01	DE87753008	MN -20a	12:44659
131	NTIS (US Sales Only), PC A03/MF A01	DE87753010	MN -20a	12:44660
132	NTIS (US Sales Only), PC A05/MF A01	DE87753007	MN -20g	12:44661
IAEA-SM-				
295/ 35	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011673	MN -80	12:43350
295/ 40	*See* BNL-NUREG-40049	E 1.99: DE87013299	MN -80	12:43336
IAEA-TECDOC-				
412	NTIS (US Sales Only), PC A08/MF A01	DE87702566	MN -80	12:43305

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ICASE-				
87-7	*See* N-87-22444			12:44785
IFP-				
32-004	NTIS (US Sales Only), PC A08/MF A01; 1	DE87753163	MN -64	12:43812
33-343	NTIS (US Sales Only), PC A08/MF A01; 1	DE87753165	MN -98	12:43400
IFSR-				
270	*See* DOE/ET/53088-270	E 1.99: DE87012234	MN -20g	12:44446
273	*See* DOE/ET/53088-273	E 1.99: DE87012233	MN -28	12:43833
281	*See* DOE/ET/53088-281	E 1.99: DE87012663	MN -20	12:44635
284	*See* DOE/ET/53088-284	E 1.99: DE87013006	MN -20f	12:44649
285	*See* DOE/ET/53088-285	E 1.99: DE87013007	MN -20f	12:44650
INIS-BR-				
672	NTIS (US Sales Only), PC A02/MF A01	DE87702594	MN -4	12:43588
712	NTIS (US Sales Only), PC A12/MF A01	DE87703464	MN -34C	12:44563
INIS-mf-				
10638	NTIS (US Sales Only), PC A04/MF A01	DE87752444	MN -34C	12:44523
10639	NTIS (US Sales Only), PC A08/MF A01	DE87752443	MN -34C	12:44542
10640	NTIS (US Sales Only), PC A04/MF A01	DE87752442	MN -34C	12:44532
10641	NTIS (US Sales Only), PC A05/MF A01	DE87752441	MN -34C	12:44543
10642	NTIS (US Sales Only), PC A05/MF A01	DE87752445	MN -34A	12:44422
10643	NTIS (US Sales Only), PC A07/MF A01	DE87752446	MN -38	12:43242
10646	NTIS (US Sales Only), PC A07/MF A01	DE87752450	MN -97c	12:43207
10648	NTIS (US Sales Only), PC A10/MF A01	DE87752451	MN -4	12:43125
10653	NTIS (US Sales Only), PC A08/MF A01	DE87752452	MN -34C	12:44544
10755	NTIS (US Sales Only), PC A08/MF A01	DE87752449	MN -25	12:43537
10756	NTIS (US Sales Only), PC A06/MF A01	DE87752448	MN -38	12:43773
10916	NTIS (US Sales Only), PC A99/MF A01	DE87702596	MN -48	12:44187
10936	NTIS (US Sales Only), PC A05/MF A01	DE87702597	MN -80	12:43291
10937	NTIS (US Sales Only), PC A16/MF A01	DE87702598	MN -48	12:44203
IPNO-DRE-				
86-07	NTIS (US Sales Only), PC A02/MF A01	DE87752339	MN -34C	12:44506
86-12	NTIS (US Sales Only), PC A02/MF A01	DE87752340	MN -34C	12:44538
IPNO-TH-				
86-57	NTIS (US Sales Only), PC A02/MF A01	DE87752341	MN -34C	12:44515
IPPCZ-				
253	NTIS (US Sales Only), PC A06/MF A01	DE87702604	MN -20	12:44662
IS-T-				
1240	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE87013606	MN -25	12:43538
1248	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE87013611	MN -4	12:43672
1280	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE87013602	MN -25	12:43624
1282	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE87013599	MN -4	12:43656
1298	NTIS, PC A10/MF A01; 1 (GPO Dep.)	E 1.99: DE87013608	MN -4	12:43539
1305	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87013604	MN -4	12:43589
1311	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE87013600	MN -48	12:44182
1315	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87013598	MN -25	12:43540
1318	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87013601	MN -4	12:43657
1325	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99: DE87013605	MN -25	12:43590
1336	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE87013610	MN -4	12:43625
JA-				
5922	*See* AD-A-180851/8/XAB			12:43748
5951	*See* AD-A-180887/2/XAB			12:43750
JAERI-				
1304	NTIS (US Sales Only), PC A05/MF A01	DE87752975	MN -25	12:44613
JAERI-M-				
86-198	NTIS (US Sales Only), PC A07/MF A01	DE87753011	MN -4	12:43658
87-003	NTIS (US Sales Only), PC A05/MF A01	DE87752988	MN -80	12:43243
87-009	NTIS (US Sales Only), PC A16/MF A01	DE87752970	MN -20d	12:44718
87-012	NTIS (US Sales Only), PC A03/MF A01	DE87752983	MN -20a	12:44680
87-015	NTIS (US Sales Only), PC A03/MF A01	DE87752976	MN -77	12:43263
87-016	NTIS (US Sales Only), PC A02/MF A01	DE87752998	MN -77	12:43264
87-017	NTIS (US Sales Only), PC A99/MF A01	DE87752989	MN -20d	12:44719
87-018	NTIS (US Sales Only), PC A13/MF A01	DE87752973	MN -20d	12:44720
87-019	NTIS (US Sales Only), PC A03/MF A01	DE87752982	MN -77	12:43351
87-020	NTIS (US Sales Only), PC A05/MF A01	DE87752977	MN -77	12:43309
87-021	NTIS (US Sales Only), PC A13/MF A01	DE87752978	MN -20d	12:44721
87-022	NTIS (US Sales Only), PC A03/MF A01	DE87752979	MN -34C	12:44587
87-023	NTIS (US Sales Only), PC A02/MF A01	DE87752974	MN -77	12:43265
87-024	NTIS (US Sales Only), PC A02/MF A01	DE87752990	MN -77	12:43266
87-026	NTIS (US Sales Only), PC A03/MF A01	DE87752980	MN -25	12:44614
87-027	NTIS (US Sales Only), PC A09/MF A01	DE87753012	MN -80	12:43352
87-028	NTIS (US Sales Only), PC A03/MF A01	DE87752984	MN -20d	12:44681
87-029	NTIS (US Sales Only), PC A03/MF A01	DE87752985	MN -20d	12:44723
87-030	NTIS (US Sales Only), PC A02/MF A01	DE87752981	MN -20d	12:44724
87-031	NTIS (US Sales Only), PC A06/MF A01	DE87753000	MN -20d	12:44725
87-032	NTIS (US Sales Only), PC A04/MF A01	DE87752994	MN -34C	12:44596
87-033	NTIS (US Sales Only), PC A05/MF A01	DE87753004	MN -70	12:43078
87-034	NTIS (US Sales Only), PC A03/MF A01	DE87752972	MN -70	12:43079
87-035	NTIS (US Sales Only), PC A02/MF A01	DE87752995	MN -70	12:43080
87-036	NTIS (US Sales Only), PC A04/MF A01	DE87752969	MN -20d	12:44726
87-037	NTIS (US Sales Only), PC A04/MF A01	DE87753006	MN -80	12:43286
87-038	NTIS (US Sales Only), PC A03/MF A01	DE87752967	MN -20d	12:44727
87-039	NTIS (US Sales Only), PC A03/MF A01	DE87752966	MN -38	12:43727
87-040	NTIS (US Sales Only), PC A03/MF A01	DE87752965	MN -70	12:43081
87-041	NTIS (US Sales Only), PC A04/MF A01	DE87752968	MN -80	12:43331

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87-042	NTIS (US Sales Only), PC A02/MF A01		DE87752991	MN -20d	12:44728
87-043	NTIS (US Sales Only), PC A11/MF A01		DE87752992	MN -80	12:43353
87-044	NTIS (US Sales Only), PC A08/MF A01		DE87752996	MN -80	12:43354
87-045	NTIS (US Sales Only), PC A02/MF A01		DE87752964	MN -20f	12:44682
87-046	NTIS (US Sales Only), PC A04/MF A01		DE87752986	MN -4	12:43697
87-047	NTIS (US Sales Only), PC A02/MF A01		DE87753003	MN -23	12:43119
87-048	NTIS (US Sales Only), PC A03/MF A01		DE87753001	MN -25	12:43626
87-049	NTIS (US Sales Only), PC A15/MF A01		DE87752993	MN -78	12:43245
87-050	NTIS (US Sales Only), PC A17/MF A01		DE87752997	MN -78	12:43256
87-051	NTIS (US Sales Only), PC A07/MF A01		DE87753015	MN -80	12:43355
87-052	NTIS (US Sales Only), PC A06/MF A01		DE87752999	MN -80	12:43356
87-053	NTIS (US Sales Only), PC A07/MF A01		DE87752987	MN -34A	12:44424
87-054	NTIS (US Sales Only), PC A02/MF A01		DE87753002	MN -20f	12:44683
87-055	NTIS (US Sales Only), PC A05/MF A01		DE87752971	MN -80	12:43326
87-057	NTIS (US Sales Only), PC A03/MF A01		DE87753005	MN -80	12:43287
87-062	NTIS (US Sales Only), PC A03/MF A01		DE87753013	MN -32	12:44780
87-065	NTIS (US Sales Only), PC A03/MF A01		DE87753018	MN -20d	12:44729
87-066	NTIS (US Sales Only), PC A03/MF A01		DE87753017	MN -20d	12:44730
87-068	NTIS (US Sales Only), PC A06/MF A01		DE87753016	MN -25	12:43541
87-069	NTIS (US Sales Only), PC A04/MF A01		DE87753014	MN -20d	12:44731
JPL-					
9950-1254	*See* N-87-22301				12:43159
JPL-PUB-					
87-2	*See* N-87-22024				12:44429
87-9	*See* N-87-22466				12:44389
JSR-					
85-405	*See* AD-A-180928/4/XAB				12:43953
K/ETAC-					
17-Pt.1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013870	MN -4	12:43542
K/HS-					
93-Rev.1	NTIS, PC A13/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012963	MN -11	12:43406
K/SUB-					
85-22224/ 2	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010836	MN -11	12:44143
KAMEDO-					
53	*See* PB-87-193009/XAB				12:43985
KEK-					
85-14	NTIS (US Sales Only), PC A05/MF A01		DE87780150	MN -34D	12:44465
86-8	NTIS (US Sales Only), PC A02/MF A01		DE87753025	MN -28	12:43852
86-9	NTIS (US Sales Only), PC A03/MF A01		DE87753024	MN -28	12:43853
KEMA-					
85-40-MOL	N.V. KEMA, P.O. Box 9035, 6800 ET Arnhem, Netherlands			ND -103	12:42976
5342-85-MOL	N.V. KEMA, P.O. Box 9035, 6800 ET Arnhem, Netherlands			ND -105	12:42969
KEMA-DPA-					
641-85	N.V. KEMA, P.O. Box 9035, 6800 ET Arnhem, Netherlands			ND -60	12:43199
KURRI-TR-					
274	NTIS (US Sales Only), PC A05/MF A01		DE87780151	MN -2	12:44809
LA-					
10933-MS	NTIS, PC A16; 3		DE87012705	STD -96	12:43498
10956-C	NTIS, PC A12/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012707	STD -34	12:44514
11020-MS	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013053	MN -32	12:44781
11027-MS	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012671	MN -28	12:43854
11028-MS	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012672	MN -28	12:43855
11030-PR	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012333	MN -80	12:44597
11045-MS	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012676	MN -109	12:42977
11058-MS	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012694	STD -34	12:43627
LA-UR-					
86-556	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013293	MN -70	12:44227
87-928	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87007453	MN -45	12:43941
87-1035	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87007509	MN -25	12:43543
87-1526	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010104	MN -11	12:44221
87-1611	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010116	MN -34	12:43673
87-1755	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87010132	MN -34	12:44615
87-1846	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011796	MN -20g	12:44732
87-1863	NTIS, PC A02; 3		DE87011793	MN -48	12:44185
87-1980	NTIS, PC A02; 3		DE87011779	MN -38	12:43728
87-1981	NTIS, PC A02; 3		DE87011778	MN -38	12:43774
87-2003	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011775	MN -80	12:43274
87-2052	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87011769	MN -34	12:44449
87-2078	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011767	MN -34A	12:44425
87-2079	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011766	MN -21	12:43787
87-2094	NTIS, PC A02; 3		DE87011763	MN -38	12:43788
87-2102	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011760	MN -20f	12:44684
87-2118	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011750	MN -28	12:43757
87-2121	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87011748	MN -34	12:43628
87-2124	NTIS, PC A03; 3		DE87011747	MN -38	12:43711
87-2153	NTIS, PC A02; 3		DE87011739	MN -34	12:44426
87-2155	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011738	MN -28	12:43856
87-2171	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011736	MN -34	12:43544
87-2187	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011735	MN -32	12:44810
87-2192	NTIS, PC A02; 3		DE87011734	MN -38	12:43789
87-2199	NTIS, PC A02; 3		DE87011732	MN -38	12:43729

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87-2223	NTIS, PC A02; 3		DE87013132	MN -15	12:43108
87-2241	NTIS, PC A02; 3		DE87013133	MN -15	12:43109
87-2249	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE87011728	MN -34A	12:44427
87-2254	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013136	MN -37	12:43904
87-2282	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87013140	MN -38	12:43730
87-2313	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013148	MN -34A	12:44428
87-2314	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013149	MN -34B	12:44253
87-2321	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013151	MN -28	12:43834
87-2456	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013163	MN -25	12:43510
87-2571	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE87013175	MN -25	12:43545
87-2603	NTIS, PC A02; 3		DE87013178	MN -13	12:44757
LAL-					
86-20	NTIS (US Sales Only), PC A02/MF A01		DE87752200	MN -34D	12:44466
86-28	NTIS (US Sales Only), PC A02/MF A01		DE87752230	MN -34D	12:44494
86-32	NTIS (US Sales Only), PC A02/MF A01		DE87752201	MN -34D	12:44467
LALP-					
87-10	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013329	MN -25	12:44758
LBL-					
21597	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013988	MN -95d	12:43481
21598	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013987	MN -95d	12:43482
22153	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013959	STD -11	12:43980
22154	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013958	STD -13	12:43981
22155	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013957	MN -13	12:43443
22236	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87011093	MN -28	12:43857
22393	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010986	MN -32	12:44811
22627	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013986	MN -95d	12:43483
22743	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013956	STD -62c	12:43176
22837	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87012881	MN -25	12:43546
23147	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013972	STD -108	12:42918
23195	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013970	STD -11	12:44450
23283	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013967	STD -13	12:44759
23326	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010988	MN -21	12:44733
23371	NTIS, PC A02; 3		DE87011226	MN -70	12:43082
23409	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013985	MN -34C	12:43858
23435	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013966	STD -34C	12:44486
23464	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011102	MN -11	12:44222
23468	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012886	MN -34	12:43731
23476	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87011377	MN -34C	12:44534
23492	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014120	MN -25	12:43629
23522	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012889	MN -20c	12:43630
23531	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87011101	MN -34	12:43547
23596	NTIS, PC A14/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014086	MN -94cc	12:43691
23601	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012880	MN -32	12:44812
23623	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012876	MN -28	12:43818
23625	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012711	MN -32	12:44782
23649	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013963	STD -108	12:42919
23664	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013962	STD -37	12:43923
23667	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014113	MN -4	12:43674
23688	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014085	MN -34C	12:44468
23698	NTIS, PC A10/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014133	MN -94cc	12:44451
LBL-PUB-					
3062	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014073	MN -38	12:44783
3064	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012712	MN -32	12:43819
5198	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014074	MN -2	12:43414
LBL/SRP-					
23344	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013960	STD -70	12:43083
LYCEN-					
8213	NTIS (US Sales Only), PC A02/MF A01		DE87752228	MN -34D	12:44636
8503	NTIS (US Sales Only), PC A05/MF A01		DE87752231	MN -4	12:43659
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1408	*See* AD-B-955852/9/XAB				12:43613
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1791	*See* AD-B-955855/2/XAB				12:43616
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83-069	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE87003845	STD -112	12:43437
MS-					
7124C	*See* AD-A-180788/2/XAB				12:43746
7223	*See* AD-A-180715/5/XAB				12:43745
7325	*See* AD-A-180821/1/XAB				12:43747
MTB-					
175	NTIS (US Sales Only), PC A02/MF A01		DE87753019	MN -25	12:43780
MTL-TR-					
87-15	*See* AD-A-181256/9/XAB				12:43612
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87-21994	NTIS, PC A04/MF A01				12:43185
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87-22003	NTIS, PC A02/MF A01				12:43275
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87-22024	NTIS, PC A05/MF A01			12:44429
87-22028	NTIS, PC A03/MF A01			12:43706
87-22033	NTIS, PC A04/MF A01			12:43548
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87-22048	NTIS, PC A02/MF A01			12:43675
87-22052	NTIS, PC A02/MF A01			12:43591
87-22098	NTIS, PC A02/MF A01			12:43158
87-22174	NTIS, PC A02/MF A01			12:43375
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87353	See N-87-22860			12:43555
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89881	See N-87-22307			12:43381
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NASA-TT-				
20010	See N-87-22018			12:43330
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250	*See* N-87-22958			12:44598
NBSIR-				
86-3429	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87013946	MN -38	12:44599
87-3548	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013947	MN -34A	12:43906
NCAR/TN-				
276-STR	*See* PB-87-200580/XAB			12:44374
280-STR	*See* PB-87-196382/XAB			12:44373
ND-R-				
1266(D)	United Kingdom Atomic Energy Authority Risley, Warrington WA3 6AT	TI87900940	ND -86	12:43033
NIPER-				
187	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87001257	STD -125	12:43002
NOAA-TM-NESDIS-				
31	*See* PB-87-196424/XAB			12:44410
NOAA-TM-NMFS-F/NWC-				
111	*See* PB-87-198859/XAB			12:44215
NP-				
7752962	NTIS (US Sales Only), PC A03; 3	DE87752962	MN -97e	12:43137
7900801	NTIS (US Sales Only), PC A02/MF A01; 1	DE87900801	MN -05	12:43423
7900896	The Governor's Energy Office, The Capitol, Tallahassee, FL 32301	TI87900896	MN -05	12:43415
7900935	Charles R. Guinn, New York State Energy Office, Agency Building No. 2, Empire State Plaza, Albany, NY 12223-0001	TI87900935	MN -98C	12:43006
7900937	Charles R. Guinn, New York State Energy Office, Agency Building No. 2, Empire State Plaza, Albany, NY 12223-0001	TI87900937	MN -98E	12:43429
NPS-				
56-87-001	*See* AD-A-180893/0/XAB			12:43952
NRC-				
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5944	*See* AD-A-180640/5/XAB			12:44631
5964	*See* AD-A-181047/2/XAB			12:44231
NSWC-TR-				
85-398	*See* AD-A-180862/5/XAB			12:43376
NTSB/MAR-				
87/ 05	*See* PB-87-916405/XAB			12:43001
NUREG-				
0040-Vol.11-No.2	NTIS, PC A08/MF A01 - GPO	TI87900953	MN -80	12:43279
0090-Vol.9-No.4	NTIS, PC A04/MF A01 - GPO	TI87900928	MN -80	12:43280
0327-Rev.4	NTIS, PC A03/MF A01 - GPO	TI87900926	MN -80	12:43238
0540-Vol.9-No.6	NTIS, PC A22 - GPO	DE87900927	MN -2	12:43281
0750-Vol.24-Index.2	NTIS, PC A05 - GPO	DE87900950	MN -2	12:43282
0750-Vol.25-No.2	NTIS, PC A04 - GPO	DE87900895	MN -80	12:43416
0750-Vol.25-No.3	NTIS, PC A07 - GPO	DE87900952	MN -80	12:43283
0781-Suppl.4	NTIS, PC A08/MF A01 - GPO	TI87900929	MN -78	12:43357
0904-Suppl.1	NTIS, PC A21/MF A01 - GPO	TI87900832	MN -11	12:43..10
0936-Vol.6-No.2	NTIS, PC A06/MF A01 - GPO	TI87900947	MN -2	12:43358
1057-Suppl.6	NTIS, PC A05/MF A01 - GPO	TI87900956	MN -78	12:43359
1245-Vol.1	NTIS, PC A04/MF A01 - GPO	TI87900731	MN -70	12:43084
1253	NTIS, PC A22/MF A01	TI87900882	MN -78	12:43246
1264	NTIS, PC A03/MF A01 - GPO	TI87900955	MN -80	12:43360
1274	NTIS, PC A02/MF A01 - GPO	TI87900951	MN -70B	12:43085
1276	NTIS, PC A21/MF A01 - GPO	TI87900897	MN -78	12:43257
1279	NTIS, PC A18/MF A01 - GPO	TI87900957	MN -78	12:43258
1281	NTIS, PC A05 - GPO	DE87900945	MN -83	12:43327
1282	NTIS, PC A02/MF A01 - GPO	TI87900944	MN -80	12:43361
1284	NTIS, PC A12/MF A01 - GPO	TI87900909	MN -80	12:43312
NUREG/CR-				
2000-Vol.5-No.12	NTIS, PC A07/MF A01 - GPO	TI87005545	MN -80	12:43284
2907-Vol.5	NTIS, PC A12/MF A01 - GPO	TI87013757	MN -11	12:43316
4161-Vol.3	NTIS, PC A03/MF A01 - GPO	TI87011815	MN -70	12:43086
4640	NTIS, PC A06/MF A01 - GPO	TI87014052	MN -80	12:43239
4731-Vol.1	NTIS, PC A09/MF A01 - GPO	TI87013352	MN -78	12:43247
4747-Vol.1	NTIS PC E06/MF A01; 1	TI87013863	MN -78	12:43362
4767	NTIS, PC A99/MF A01 - GPO	TI87013503	MN -78	12:43363
4779	NTIS, PC A03/MF A01 - GPO	TI87010941	MN -11	12:44029
4850	NTIS, PC A06/MF A01 - GPO	TI87013008	MN -78	12:43259
4910	NTIS, PC A10/MF A01 - GPO	TI87900954	MN -78	12:43364
4913	NTIS, PC A23 - GPO	TI87012895	MN -78	12:43299
4945	NTIS, PC A12/MF A01 - GPO	TI87013332	MN -78	12:43365
4953	NTIS, PC A07/MF A01 - GPO	TI87900898	MN -78	12:43366
4962	NTIS, PC A05/MF A01	TI87900958	MN -80	12:43367
4972	NTIS, PC A04/MF A01 - GPO	TI87013015	MN -78	12:43368
4982	NTIS, PC A08/MF A01 - GPO	TI87013442	MN -78	12:43041
OCS/MMS-				
85/ 0112	*See* PB-87-195954/XAB			12:44118
86/ 0020	*See* PB-87-196432/XAB			12:44112
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ORNL-				
6385	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99: DE87013361	MN -4	12:43650
ORNL/FEDC-				
87/ 3	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87013377	STD -20c	12:44734
ORNL/M-				
379	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013129	MN -97	12:43237
382	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013524	MN -11	12:44033
396	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87013869	MN -25	12:43556
ORNL/NSIC-				
200-Vol.5-No.12	*See* NUREG/CR-2000-Vol.5-No.12	TI87005545	MN -80	12:43284
ORNL/Sub-				
84-89628/ 01	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99: DE87013401	MN -114	12:43557
ORNL/TM-				
9883	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87013363	STD -70B	12:43087
9981	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87014111	MN -95d	12:43452
10006	NTIS, PC A12/MF A01; 1 (GPO Dep.)	E 1.99: DE87013376	MN -70A	12:44051
10008	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE87001910	MN -70A	12:44052
10296	NTIS, PC A10/MF A01; 1 (GPO Dep.)	E 1.99: DE87013374	MN -11	12:44042
10316	NTIS, PC A15/MF A01; 1 (GPO Dep.)	E 1.99: DE87013368	MN -32	12:44787
10453	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87013371	MN -11	12:43105
ORNL/tr-				
87/ 15	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99: DE87011875	MN -28	12:43896
OTA-				
0-334	*See* PB-87-194585/XAB			12:44116
PAD-				
77-9	*See* DOE/MA-0282	E 1.99: DE87013099	MN -13	12:44764
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6244	NTIS PC E06/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013296	MN -70	12:43088
6247	NTIS, PC A10/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014260	MN -95f	12:43511
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14908	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87011993	MN -70B	12:43089
14925	*See* UNI-SA-207	E 1.99: DE87012230	MN -80	12:43639
15051	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013327	MN -11	12:44032
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10	NTIS (US Sales Only), PC A07/MF A01	DE87780152	MN -23	12:43701
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2426	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87013212	STD -20f	12:44736
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2436	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87013208	STD -20f	12:44689
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3948	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87013380	MN -15	12:43111
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4146	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013385	MN -15	12:43112
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155-P	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99: DE87013005	MN -70	12:43090
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658	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87012639	MN -70	12:43091
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2637	NTIS (US Sales Only), PC A04/MF A01	DE87752410	MN -37	12:43907
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87-2	NTIS (US Sales Only), PC A03/MF A01	DE87753021	MN -34D	12:44496
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86-2268C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013069	MN -37	12:43908
86-2339C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87011282	MN -45	12:43942
86-2419	*See* NUREG/CR-4767	TI87013503	MN -78	12:43363
86-2944C	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87004522	MN -96A	12:43469
86-2952C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011716	MN -13	12:44765
86-7167	NTIS, PC A19/MF A01; 1 (GPO Dep.)	E 1.99: DE87009387	MN -70	12:43096
87-0017C	NTIS, PC A02; 3	DE87012020	MN -37	12:43791
87-0081C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011283	MN -28	12:43860
87-0084C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011284	MN -28	12:43861
87-0100C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011856	MN -38	12:43792
87-0107C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011725	MN -28	12:43862
87-0128C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87014170	MN -25	12:43736
87-0172C	NTIS, PC A02; 3	DE87012014	MN -21	12:44738
87-0189C	NTIS, PC A02; 3	DE87011862	MN -28	12:43863
87-0257C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011632	MN -21	12:44739

Report Number	Availability Source	File Number	Distribution Category	Abstract Number
87-0292C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012370	MN -34A	12:44789
87-0303C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011863	MN -21	12:43820
87-0314C	NTIS, PC A02/MF A01; 3	DE87011723	MN -28	12:43821
87-0455	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87012510	MN -28	12:43835
87-0460C	NTIS, PC A02; 3	DE87011857	MN -21	12:44740
87-0580	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012515	MN -37	12:43793
87-0619C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87008514	MN -34	12:44411
87-0662C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012974	MN -34	12:44790
87-0766	NTIS, PC A04/MF A01; 1	DE87013593	MN -34	12:44616
87-0891	*See* NUREG/CR-4913	TI87012895	MN -78	12:43299
87-0923C	NTIS, PC A02; 3	DE87013083	MN -66a	12:43189
87-0931C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87012738	MN -37	12:43926
87-0944C	NTIS, PC A02; 3	DE87011865	MN -32	12:44813
87-0953C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87009715	MN -94cc	12:43794
87-0962	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE87012512	MN -28	12:43822
87-0984	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87014267	MN -13	12:44761
87-1024C	NTIS, PC A02; 3	DE87012019	MN -32	12:43795
87-1031C	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87012407	MN -34	12:44617
87-1128	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013844	STD -15	12:43113
87-1156C	NTIS, PC A02; 3	DE87009297	MN -25	12:43559
87-1213C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87014171	MN -25	12:43633
87-1238	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87012341	MN -37	12:43927
87-1296	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87013976	MN -25	12:43560
87-1319C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010038	MN -38	12:43782
87-1367C	NTIS, PC A02; 3	DE87012130	MN -37	12:43796
87-1379	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87012998	MN -37	12:43928
87-1688C	NTIS, PC A02; 3	DE87012128	MN -20c	12:44741
87-1745C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012403	MN -32	12:44791
87-1750	NTIS, PC A13/MF A01; 1 (GPO Dep.)	E 1.99: DE87013845	MN -63	12:43163
87-1883C	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87013809	MN -25	12:43634
87-7031C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012372	MN -28	12:43864
87-7096	NTIS PC E07/MF A01; 1 (GPO Dep.)	E 1.99: DE87013833	MN -126	12:43003
87-7112	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE87012842	MN -63	12:43164
87-7127C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010737	MN -94cb	12:43385
87-8224	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87014266	MN -25	12:43635
SC-				
5100.24FR	*See* AD-B-036437/2/XAB			12:43513
SCIENTIFIC-				
3	*See* AD-A-181152/0/XAB			12:43954
SDL-				
85-075	*See* AD-A-181247/8/XAB			12:44385
SERI/SP-				
271-2892	NTIS, PC A13; 3	DE87001181	MN -59A	12:43181
SERI/STR-				
231-3182	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99: DE87012267	MN -61G	12:43134
231-3192	NTIS, PC A10/MF A01; 1 (GPO Dep.)	E 1.99: DE87012276	MN -61E	12:43135
SGD-				
512-PT-1	*See* PB-87-195251/XAB			12:44371
SKB-TR-				
85-13	NTIS (US Sales Only), PC A03/MF A01	DE87780173	MN -70	12:43097
85-14	NTIS (US Sales Only), PC A04/MF A01	DE87780172	MN -70	12:43098
SLAC-PUB-				
3774	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012319	MN -28	12:43823
4091	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012841	MN -28	12:43824
4161	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010540	MN -28	12:43836
4227	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012839	MN -28	12:43837
4278	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012838	MN -28	12:43838
4320	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012835	MN -28	12:43839
4325	NTIS, PC A02; 3	DE87013584	MN -34D	12:44498
4329	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012833	MN -28	12:43865
4345	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012317	MN -32	12:44792
SOL-				
87-8	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87012728	MN -32	12:44793
SSI-				
86-10	NTIS (US Sales Only), PC A03/MF A01	DE87752423	MN -41	12:43370
86-28	NTIS (US Sales Only), PC A03/MF A01	DE87752417	MN -41	12:43371
87-05	NTIS (US Sales Only), PC A02/MF A01	DE87752418	MN -41	12:43372
STF-				
21-A86105	*See* PB-87-205134/XAB			12:42999
STUK-A-				
66	NTIS (US Sales Only), PC A03/MF A01	DE87752412	MN -11	12:44131
TE-				
4362-152-85	*See* AD-A-180926/8/XAB			12:43752
THE-R-				
812-D	Technical Univ. Eindhoven, Physics Dept., P.O. Box 513, 5600 MB Eindhoven, Netherlands		ND -60	12:43200
815-D	Technical Univ. Eindhoven, Physics Dept., P.O. Box 513, 5600 MB Eindhoven, Netherlands		ND -60	12:43201
816-D	Technical Univ. Eindhoven, Physics Dept., P.O. Box 513, 5600 MB Eindhoven, Netherlands		ND -60	12:43202
817-D	Technical University Eindhoven, Physics Dept., P.O. Box 513, 5600 MB Eindhoven, Netherlands		ND -60	12:43203
818-D	Technical Univ. Eindhoven, Physics Dept., P.O. Box 513, 5600 MB Eindhoven, Netherlands		ND -60	12:43195

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TKK-F-A-				
606	*See* PB-87-196275/XAB			12:44454
607	*See* PB-87-196234/XAB			12:44452
610	*See* PB-87-196267/XAB			12:44453
TNO-HMT-				
85-02386	Hoofdgroep Maatschappelijke Technologie TNO, P.O. Box 342, 7300 AH Apeldoorn, Netherlands		ND -25	12:43636
86-213	Hoofdgroep Maatschappelijke Technologie TNO, P.O. Box 342, 7300 AH Apeldoorn, Netherlands		ND -103	12:42979
TNO-PML-				
1985-C-56	Prins Maurits Laboratorium TNO, P.O. Box 45, 2280 AA Rijswijk, Netherlands		ND -113	12:42973
TR-				
87-06	*See* DOE/ER/25010-T3	E 1.99: DE87012955	MN -32	12:44779
772	*See* AD-A-180848/4/XAB			12:43918
TRI-PP-				
87-8	NTIS (US Sales Only), PC A02/MF A01; 1	DE87900855	MN -28	12:43825
87-10	NTIS (US Sales Only), PC A02/MF A01; 1	DE87900857	MN -28	12:43840
87-11	NTIS (US Sales Only), PC A02/MF A01; 1	DE87900858	MN -28	12:43866
87-12	NTIS (US Sales Only), PC A02/MF A01	DE87900859	MN -28	12:43867
87-13	NTIS (US Sales Only), PC A02/MF A01; 1	DE87900860	MN -28	12:43868
87-14	NTIS (US Sales Only), PC A02/MF A01; 1	DE87900861	MN -28	12:43869
87-15	NTIS (US Sales Only), PC A02/MF A01; 1	DE87900862	MN -28	12:43895
87-16	NTIS (US Sales Only), PC A02/MF A01; 1	DE87900863	MN -28	12:43841
87-25	NTIS (US Sales Only), PC A02/MF A01	DE87900864	MN -28	12:43826
87-27	NTIS (US Sales Only), PC A02/MF A01; 1	DE87900866	MN -28	12:43870
87-28	NTIS (US Sales Only), PC A02/MF A01; 1	DE87900867	MN -28	12:43871
87-29	NTIS (US Sales Only), PC A02/MF A01; 1	DE87900868	MN -28	12:43872
87-30	NTIS (US Sales Only), PC A02/MF A01	DE87900869	MN -28	12:43842
87-31	NTIS (US Sales Only), PC A02/MF A01; 1	DE87900870	MN -28	12:43873
87-32	NTIS (US Sales Only), PC A02; 3	DE87900871	MN -28	12:43874
87-33	NTIS (US Sales Only), PC A02; 3	DE87900872	MN -28	12:43875
87-34	NTIS (US Sales Only), PC A02; 3	DE87900873	MN -28	12:43876
87-35	NTIS (US Sales Only), PC A02; 3	DE87900874	MN -28	12:43877
87-36	NTIS (US Sales Only), PC A02; 3	DE87900875	MN -28	12:43878
87-37	NTIS (US Sales Only), PC A02; 3	DE87900876	MN -28	12:43879
87-38	NTIS (US Sales Only), PC A02; 3	DE87900877	MN -28	12:43880
TTC-				
0702	*See* SAND-85-2180	DE87013841	MN -11	12:43966
UCID-				
19592-Rev.3	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99: DE87012830	MN -32	12:44794
20092-Vol.3	*See* NUREG/CR-4161-Vol.3	TI87011815	MN -70	12:43086
20545	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE87013297	MN -32	12:44795
20622-85-11	NTIS, PC A09; 3	DE87013475	MN -4	12:43652
20622-86-7	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE87012976	MN -4	12:43653
20931	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE87013834	MN -11	12:44210
20987	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87012311	MN -38	12:43737
21035	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99: DE87013573	MN -37	12:43124
21076	NTIS, PC A02; 3	DE87013118	MN -34A	12:44431
21078	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013572	MN -34A	12:43758
21103	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87012571	MN -34A	12:44432
21107	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013218	MN -32	12:44796
21115	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013574	MN -32	12:44797
21131	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87014279	MN -38	12:43783
UCRL-				
15924	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE87012912	MN -32	12:44798
15926	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013494	MN -38	12:43779
15927	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013495	MN -34B	12:44375
53689-86	NTIS, PC A15/MF A01; 1 (GPO Dep.)	E 1.99: DE87013979	STD -2	12:44228
53812	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87014275	STD -13	12:44762
94424	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011565	MN -37	12:43660
94675	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011878	MN -38	12:43738
95340	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013105	MN -25	12:43637
95443	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87010340	MN -45	12:43943
95459	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87008421	MN -35	12:43944
95461	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87008423	MN -35	12:43945
95462	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012177	MN -45	12:43946
95483	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87009581	MN -35	12:43947
95611	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012661	MN -38	12:43759
95626	NTIS, PC A02; 3	DE87013560	MN -16	12:43114
95670	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87012628	MN -34A	12:43760
95733	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011322	MN -21	12:44742
95818	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87009137	MN -45	12:43948
95832	NTIS, PC A02; 3	DE87013561	MN -25	12:43561
95843	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011308	MN -38	12:43739
95849	NTIS, PC A02; 3	DE87012914	MN -21	12:43761
95895	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013221	MN -34C	12:44603
95909	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011560	MN -28	12:43827
95927	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87011923	MN -20	12:44743
95967	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013488	MN -34C	12:44376
95988	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011884	MN -25	12:43562
96001	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011922	MN -20b	12:44744
96045	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013224	MN -15	12:43115
96076	NTIS, PC A02; 3	DE87007322	MN -38	12:43712

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96092	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87010870	MN -11	12:43967
96184	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013497	MN -25	12:43676
96282	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87011920	MN -32	12:44799
96344	NTIS, PC A02; 3		DE87011559	MN -25	12:43563
96361	NTIS, PC A02; 3		DE87013484	MN -25	12:43564
96376	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013786	MN -38	12:43784
96378	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87011323	MN -32	12:44814
96398	NTIS, PC A02; 3		DE87013486	MN -38	12:43740
96435	NTIS, PC A02; 3		DE87012245	MN -34	12:43638
96461	NTIS, PC A02; 3		DE87013115	MN -109	12:42922
96464	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013794	MN -109	12:42923
96496	NTIS, PC A02; 3		DE87013227	MN -4	12:43565
96498	NTIS, PC A02; 3		DE87012631	MN -34	12:44618
96521	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013788	MN -34A	12:44619
96523	NTIS, PC A02; 3		DE87013787	MN -34B	12:44377
96524	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012633	MN -34	12:44620
96531	NTIS, PC A02; 3		DE87011327	MN -32	12:44800
96661	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011553	MN -20a	12:44745
96696	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013801	MN -25	12:43566
96697	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010808	MN -13	12:44763
96724	NTIS, PC A02; 3		DE87010810	MN -11	12:44053
96803	NTIS, PC A02; 3		DE87012632	MN -4	12:43949
96829	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE87011571	MN -20f	12:44697
96832	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87012909	MN -21	12:44746
96905	NTIS, PC A02; 3		DE87013473	MN -15	12:43116
96913	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012240	MN -34A	12:44433
96914	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87012904	MN -48	12:43165
96930	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012242	MN -34A	12:43677
96931	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012629	MN -80	12:43313
96933	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013225	MN -15	12:43117
97081	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013114	MN -34C	12:44568
97153	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013795	MN -34C	12:44569
97182	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013791	MN -34C	12:44604
97186	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013800	MN -34A	12:44621
97203	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013793	MN -109	12:42924
ULRF-					
4341CAR	*See* AD-A-180990/4/XAB				12:44384
UNC/GJ-					
29(TMC)	*See* DOE/ID/12584-7	E 1.99:	DE87013847	STD -70A	12:43104
31-TMC	*See* DOE/ID/12584-1	E 1.99:	DE87010853	STD -70A	12:44047
36-TMC	*See* DOE/ID/12584-9	E 1.99:	DE87013579	STD -70A	12:43052
UNI-					
3251	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012223	MN -80	12:43328
UNI-M-					
76-Rev.2	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012476	MN -80	12:43318
UNI-SA-					
190	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012225	MN -80	12:43332
207	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012230	MN -80	12:43639
208	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012231	MN -80	12:43333
UR-					
1023	*See* DOE/ER/02171-227	E 1.99:	DE87014043	MN -34C	12:44560
USGS/MAP/I-					
1728	US Geological Survey, Open File Service, Box 25425, Denver Federal Center, Denver, CO 80225		TI87013514	MN -11	12:44223
USGS-WSP-					
2300	*See* PB-87-198552/XAB				12:44144
UT/CFE-PR-					
4	*See* PB-87-190641/XAB				12:43859
UTD-GRL-					
8602	*See* AD-A-180977/1/XAB				12:43753
UTSI-					
87-05	*See* DOE/ET/10815-120	E 1.99:	DE87012966	MN -112	12:43435
VPI-E-					
85.28	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013945	MN -59B	12:43187
VPI-VWRRC-Bull-					
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P	Patent
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D	Dissertation
TG	Translation (general)
TA	Translation (analytic)

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SK Sikkim
SL Sierra Leone
SM San Marino
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SO Somalia
SU Union of Soviet Socialist Republics (USSR)
SV El Salvador
SY Syria
SZ Swaziland

TD Chad
TG Togo
TH Thailand
TN Tunisia
TO Tonga
TR Turkey
TT Trinidad and Tobago
TW Taiwan
TZ United Republic of Tanzania

UA Ukrainian Soviet Socialist Republic (Ukrainian SSR)
UG Uganda
US United States of America (USA)
UY Uruguay

VA Holy See
VE Venezuela
VI Virgin Islands of the United States
VN Viet Nam

WS Western Samoa

YD Democratic Yemen
YE Yemen
YU Yugoslavia

ZA South Africa
ZM Zambia
ZR Zaire
ZW Zimbabwe

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